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Issued October 28, 1910.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF CHEMISTRY—BULLETIN No. 134.

H. W. WILEY, Chief of Bureau.

MAPLE-SAP SIRUP:

ITS MANUFACTURE, COMPOSITION, AND EFFECT OF ENVIRONMENT THEREON.

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WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1910.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., May 25, 1910.

Sir: I have the honor to transmit for your approval a report on the manufacture and analysis of maple-sap sirup prepared in the Sugar Laboratory of this Bureau after an extensive investigation. Though considerable work has been done along this line by individuals on a comparatively small number of samples representing restricted areas, no systematic study covering such a wide field as in the present case previously has been made. The analyses given represent 481 samples of maple sirups of known purity from the most important maple-producing States of this country and from Canada; they form, therefore, a basis for the comparison and grading of maple sirups. The studies of the effect of environment on the composition of this product constitute another contribution to the general investigations on the effect of environment on composition, especially of sugar-producing plants, which have been prosecuted in this Bureau since 1887.

The bulk of the analytical work reported was performed by C. G. Church and S. F. Sherwood of the Sugar Laboratory. Acknowledgment is also made of the valuable suggestions offered by Mr. C. H. Jones of Vermont and Mr. J. H. Grimm of Canada, especially in regard to the production of maple sirup in their respective localities. I recommend that this report be published as Bulletin 134 of the Bureau of Chemistry.

Respectfully,

H. W. Wiley,
Chief.

Hon. James Wilson,
Secretary of Agriculture.

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MAPLE-SAP SIRUP.

INTRODUCTION.

ORIGIN AND NATURE OF MAPLE SIRUP.

The manufacture of maple sirup probably dates back to a period before the advent of the white man in this country. Henshaw,[a] Chamberlain,[b] and Sy[c] have reviewed many of the writings of the early discoverers in which allusions are made to the preparation by the Indians of a kind of sugar and sirup from the sap of the maple tree. There is no agreement, however, as to who discovered the fact that this tree possesses a sweet sap. Some claim that the French taught the Indians how to make the sirup and sugar, and others that the Indians taught the white people, the latter theory appearing to be the more probable one. The sirup manufactured from the sap of the maple tree has become a staple article concerning whose character and constitution there is considerable discussion. Obviously the sap of a living maple tree, boiled down to the proper consistency (see pages 8 and 60), without the addition of any foreign substance other than the usual cleansing materials, is a maple sirup. However, a maple sirup may also be made by dissolving in water the solid or semisolid product resulting from boiling the sap down to the point of crystallization, with or without the use of cleansing agents. The latter is a maple-sugar sirup while the former is a maple-sap sirup—both are maple sirups. It is wrong to style a sirup made by dissolving maple sugar a maple-sap sirup. True, it has come originally from the maple sap, but by evaporating further, making sugar and then dissolving it in water, the taste and color have been changed somewhat and it becomes a maple-sugar sirup. Buyers classify sirup as "sap" sirup and "sugar" sirup, and claim that by taste and consistency they are able to distinguish one from the other.

The sap of the tree is obtained by tapping it; chopping down the tree and then extracting the dead wood with water does not yield a sap, nor does an extract prepared from maple wood, cut and cured under ordinary conditions, contain any appreciable amounts

[a] Amer. Anthropologist, 1890, 3: 341.
[b] Ibid., 1891, 4: 39.
[c] J. Frank. Inst., October, 1908.

of sucrose, and since this is the principal sugar of maple sap, and hence of the sirup, such a concentrated extract could not be called a maple sirup, nor could the name be properly applied to a product flavored with such an extract.

It appears from an examination of the maple products collected that the term "maple sirup" should be applied only to the finished product, which should not weigh less than 11 pounds to the gallon nor contain more than 35 per cent of water. A sap that is boiled to a half or two-thirds of the consistency prescribed can hardly be called a standard or commercial maple sirup. A product having 40 per cent or more of water does not have the consistency of a sirup, and is nothing more than a partially thickened sap or thin sirup.

The tree is tapped generally by boring a clean-cut hole from three-eighths to half an inch in diameter and about 1 to 3 inches deep, according to the size of the tree. After cleaning the hole, a suitable "spile" or metal spout is driven in tightly so as to prevent leaking and a bucket is attached to catch the sap. The tapping is done just before the approach of spring so as to obtain the earliest run of sap. The side of the tree to be tapped, the height of the hole above the ground, and the number of holes to a tree are points that have been much discussed. Jones, Edson, and Morse have studied these questions thoroughly as well as the subject of maple-sap flow and have published their results in Bulletin 103 of the Vermont Agricultural Experiment Station. A discussion of the care of a maple grove by Fox and Hubbard is given in Bulletin 59 of the Bureau of Forestry, Department of Agriculture.

The sugar maple grows over a wide area, but for the production of sugar in commercial quantities its range is limited to western New England, New York, Pennsylvania, the Southern Appalachians, the Ohio Valley, the Lake States, and the adjacent parts of Canada.[a] All species of the maple have a sweet sap, but the most important for the production of sugar and sirup are the sugar maple (*Acer saccharum*), and the black maple (*Acer saccharum nigrum*). The red maple (*Acer rubrum*), the silver maple (*Acer saccharinum*), and the Oregon maple (*Acer macrophyllum*), varieties thriving in swampy, wet soils, do not produce as high grade sirup or sugar, or yield as heavily, as those growing on dry lands.

MANUFACTURING PROCESSES.

In the early days of the manufacture of maple sirup the processes and apparatus were very crude. The sap was collected from the trees in hollow logs or in boxes made from birch bark and transferred to large vessels of the same material. It was then carried to the

[a] U. S. Dept. Agr., Bureau of Forestry Bul. 59, p. 19.

evaporation or boiling plant in buckets suspended from a yoke carried over the shoulder. This method has been superseded by a collecting can on a sled drawn by a team (fig. 4), or by a pipe line from the individual buckets, or from stationary tanks placed at intervals. These tanks are high enough to be drained into a central tank at the evaporation house.

The Indians boiled or thickened the sap by placing it in clay or bark vessels and dropping in heated stones. Sometimes the sap was concentrated by allowing it to freeze overnight and removing the crust of ice. The clay and wooden vessels were later replaced by copper and iron ones. The old lye or potash kettle, which was used for boiling, was suspended from sticks or placed on stones and the fire built underneath it. This method of boiling in kettles is generally practiced at small camps; the kettles are sometimes placed in the open with little or no protection, though a lean-to is often used to cover them. In other cases the concentration of the sap is effected in shallow pans not over 6 inches deep, of which there may be one or more over the same fire. If one is used, the boiling goes on continuously and generally the fresh sap is added to the boiling sirup. But if several are used, the first sap is placed in the pan farthest from the fire and when sufficiently heated is dipped or siphoned to the next pan, and so on. In this way the fresh sap is not mixed with that already boiling.

Modern evaporators are constructed on much the same principle, that is, they consist of numerous compartments and the sirup is siphoned from one to the other. The bottom, or floor of the evaporator, is corrugated to expose a greater surface to the heat, and partitions are placed in the pan to direct the flow of the juice. A constant level is sustained as the sap runs in at one end and, after traversing a distance of about 90 feet or more, is drawn off continuously. Many plants are equipped with steam evaporators which consist of copper or tin kettles with steam coils, in which the final boiling is accomplished. In a very few plants the entire evaporation is effected by steam. The practice in these plants is to reduce the sap to a thin sirup in an evaporator pan or kettle over the fire and then finish the product in steam kettles. As the sap is a nearly pure sucrose solution, normal clarification occurs during boiling, and no other is necessary. This process is more fully described on page 55.

There is a wide variation in the taste, appearance, and flavor of the product due to differences in manufacture, the greater part of the maple sirup being made on a small scale under varying conditions of care and cleanliness and with the use of different kinds of apparatus. That these varying conditions exist may be proved by comparing the widely differing products seen at the large centers where they are sold.

CONDITIONS INFLUENCING COLOR AND FLAVOR.

To just what chemical constituents maple sirup owes its particular flavor is not known. It is attributed by Wiley [a] to an ether or an aldehyde possessing a high boiling point, but nothing definite has so far been discovered in the efforts made to isolate and identify this substance.

The true flavor of maple sirup when carefully made from the sap under cleanly conditions is a very delicate one. The strong, almost rank, taste noted in some cases and often thought to indicate a richer maple product is due to a mixture of many flavors, the source of which will be discussed later. A mild, delicate taste is usually found in a light-colored sirup, and a strong flavor in a dark sirup, but the converse is not always true. The aim of the maple sugar producer to-day is to make a mild-flavored, light-colored sirup, since these characteristics are considered as indicative of a pure maple sirup. This requires careful manufacture and attention to details, though the lightness of color depends also on the kind of tree tapped, the manner of tapping, the method of collection, and the subsequent handling.

So far as can be learned, either from observation or by a survey of the literature, no sirup made from the sap of the soft maple is of light color or has a delicate taste, the tendency of this variety being to give a reddish-brown sirup with a strong flavor, but in a great many instances the soft maple is tapped early in the season, because its sap flows much more freely at that time than that of the hard maple, and by mixing the two the first sirup of the year can be produced earlier than if only the hard maple were tapped.

The flow of sap is by spells or runs, which generally occur in the daytime. One or two pleasant, warm days after a freeze may make the sap flow for some time, then a cold snap will stop the flow until the warm weather returns. During the season there may be fifteen or more runs, or there may be only two or three. The first of these runs will produce the lightest sirup, while the last run, occurring at about the time the buds are opening, very seldom produces either light-colored sirup or one of fine flavor. The taste of the sirup from the last run is popularly spoken of as "buddy." This "buddy" flavor has been attributed to changes in the composition of the sap at the time the young buds are opening. Edson [b] has recently demonstrated that a buddy flavor may be caused by the development of certain bacteria in the fresh sap, from the tap hole. He isolated and studied some of these bacteria obtained from different "sour saps" in 1907, and in the following spring treated the first run of sap with

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[a] U. S. Dept. Agr., Bureau of Forestry Bul. 59, p. 47.
[b] Vermont Agr. Exper. Sta. Bul. 151.

them. Sirup made from some of these treated saps showed all the symptoms of "buddy sap," was dark in color, had an "off" taste, and did not resemble pure maple sirup. The sap drawn from the tree under sterile conditions did not seem to contain any bacteria, showing that the contamination must enter from the outside. As a further proof that the inferior color and quality of late run sap are due to the fermentative action of micro-organisms in the spouts and buckets, trees were selected late in the season from which sour sap was being obtained. These were tapped a second time a little way from the original holes and clean spouts and buckets used. From these new tap holes a clean, clear sap came, which boiled to a light colored, fine flavored sirup, while from the old holes came the cloudy sour sap which boiled to a dark, buddy sirup.

These observations prove the necessity of keeping the buckets and holes clean. By reaming the holes during the latter part of the season souring could be partially obviated, but preferably the hole should be reamed, if three-eighths of an inch originally, with a half-inch reamer at least once in the season and twice if the season is prolonged. Without these precautions the hole becomes foul from bacterial growth, the flow of sap is retarded, and the flavor is spoiled by souring, as has been noted at the Vermont station. Again, if the sap stops flowing for a few days because of very warm weather, a freeze comes, and more sap flows, new holes should be made to obtain a light-colored sirup.

The buckets and containers which catch the sap are also an important element in the production of a light delicately-flavored sirup. Wooden buckets were used altogether formerly, but at present the tendency is toward metal ones. When wooden buckets are used they should be painted inside and out each year, which makes them easier to clean and keeps the sap out of the pores of the wood. When they are unpainted the sap soaks into the wood, and on warm days exposure to the air causes souring, which changes the flavor and always produces a darker colored sirup. This is also obviated by using metal pails, but souring will take place with the very best kind of pail if it is not kept clean. When on passing the finger around the inside of the pail at the bottom a ropy mucous membrane is found, it is to be attributed to bacterial action resulting from uncleanliness. To prevent this, the pails should be emptied daily or oftener if possible and be washed carefully after each run. Care in this regard will greatly lighten the color of the sirup.

The most important point in the selection of the buckets is that they should be carefully covered. To even a casual observer the need of covers for the buckets is obvious, but by far the greater percentage of the sirup makers do not use them. A cover keeps out rain, snow, and washings from the trees, as well as dust, insects, dried leaves,

and pieces of bark. True, the insoluble substances may be removed when the sap is poured into the container by passing it through a small mesh sieve, as is the usual practice, but the foreign material that has been dissolved remains. The snow and rain dilute the sap and hence more evaporation is necessary, while the washings of the trees always darken the sirup and also affect the flavor. It is claimed by some that the sap sours sooner in a covered bucket than in an open one. This may be true if the buckets are not kept clean, but if they are washed occasionally and the sap is collected often enough there will be little or no souring.

As the sap is a dilute solution of sugar with a little mineral and some nitrogenous matter, it forms an excellent medium for bacterial growth even under the most cleanly conditions, and when left in the bucket during a warm day there is a tendency for souring to take place; if left for a second day, it will surely sour. Freezing stops the souring temporarily, but it continues when the sap thaws. For this reason the buckets should be emptied as often as possible, at least once or twice a day. Another important point is to use an evaporation apparatus that is large enough to handle the sap of the "bush" at its maximum output. If the collected sap can be boiled immediately the danger of fermentation is largely avoided and hence a good colored and well flavored sirup is assured.

The best care should also be taken of the collecting apparatus. Wooden tanks should be painted and all collecting utensils often and thoroughly washed. Fine meshed sieves should always be kept over tanks, and these may be supplemented by cloth to prevent the entrance of fine foreign material that darkens the sirup.

At the boiling house the greatest care should be used. The arrangement should be such that the sap may be kept in a cool, clean tank, preferably outside of the house, and handled as quickly as possible. Boiling in the open, under no shelter, is not good practice, as the dirt can enter the sap freely, but equally unclean is the product made in a house with the ash pit uninclosed and a smoky atmosphere due to a poor chimney. In either case, if much dirt is present both the flavor and the color of the sirup will be changed. The use of iron kettles, iron pans, or modern evaporators in boiling are variations that also influence the color of the product.

The lightest-colored sirup is produced when the sap is boiled very fast without the addition of fresh sap. This holds good for all kinds of sirup and sugar making, whether from sugar cane, sorghum, the sugar beet, or the maple tree. To repeat the process of boiling down a weak sugar solution to a thick sirup, thinning again with fresh sap or juice, and reboiling always leads to darkened products. Theoretically, the sap should run in a constant thin layer over the heating surface, be concentrated, and then run out to the container in order

to obtain the best results. The supply should be uniform and continuous. When using iron kettles or pans this can hardly be accomplished, as they are either filled with sap and the fire built under them or are filled and swung down onto the fire by block and tackle or by the arm and the contents allowed to concentrate. With other forms of iron pans or of patent evaporators there is a continuous stream, which is siphoned over into other parts of the boiling system. The best results with iron kettles or iron pans are obtained by concentrating the charge, drawing off the sirup, and then recharging. Care should be exercised, as with all forms of evaporators, to keep the fire from touching parts of the surface not covered with the boiling sirup, which will scorch or blacken the sirup. Scorching is the cause of much of the dark-colored sirup noticed in the iron-kettle method of evaporation, as well as the fact that a great many makers add to the boiling pot all day and finish the sirup at night.

The effects of cleansing and also of lack of cleansing on the color and flavor of sirup are described under the appropriate caption (p. 54).

COLLECTION OF SAMPLES.

Many chemists have made analyses of pure maple sirups and have determined their constituents. Prominent among these are Jones, of the Vermont Agricultural Experiment Station, Hortvet, Winton, and others, while McGill has published analyses of the Canadian sirups. These results are based on samples obtained from one or more restricted localities. It might be said in this connection that it is only within the last ten years that any successful attempt has been made to differentiate between pure maple sirup and that mixed with other sugar sirups.

In order to obtain as complete a knowledge as possible of the pure maple sirups produced in the United States an investigation was begun during the maple season of 1909. Having succeeded in obtaining numerous representative samples of maple sirup from all of the important maple-producing sections of the United States, it was thought well to include also those sirups made in the Dominion of Canada just north of our boundary line. As the sirup season is very short and the field to be covered was large, it was found advisable to have the official inspectors of the Bureau collect a portion of the samples. Letters of instruction were sent out clearly defining the kind of samples wanted, the field to be covered, and the information to be obtained, including the manufacturing data, etc. The following assignments were made, and the valuable service rendered by the inspectors in the collection of samples and data is acknowledged: Indiana and western Ohio, W. H. Jenkins; Michigan, O. R. Sudler; eastern Ohio and West Virginia, William T. Ford; western New York, W. C. Miller; Pennsylvania, C. A. Meserve; central and

eastern New York, Herman Lind; Massachusetts, Maine, and New Hampshire, G. H. Adams; and Vermont and Canada, C. E. Holton. Maple sirup is also made in Illinois, Wisconsin, Minnesota, and Iowa, but its manufacture was not thought to be sufficiently extensive to call for investigation.

The inspectors were asked to describe the camp and its condition, the kind of trees, methods of collecting the sap, and the method of manufacture. They were to collect samples of maple sirup and sugar from different runs, if possible, and to be present at its manufacture whenever practicable. Reports on each sample were to be made in full. About 500 samples of maple sirup were collected in this way and 200 samples of maple sugar. The latter were stored for examination at a later date.

METHODS OF ANALYSIS AND EXAMINATION.

Analyses were begun on the sirups as soon as they were received and with the help of G. M. Bartlett, of the Boston Food and Drug Inspection Laboratory; R. S. Hiltner, of the Denver Laboratory; A. V. H. Mory, of the Kansas City Laboratory; T. F. Pappe, of the Galveston Laboratory; S. H. Ross, of the Omaha Laboratory; F. G. Smith, of the St. Paul Laboratory; and G. C. Spencer, C. P. Wilson, P. B. Dunbar, and A. L. Davison, of the Washington office, the analytical work was pushed as rapidly as possible. While awaiting analysis the sirup samples were kept in cold storage at 40° F.

Many of the samples contained varying amounts of crystallized sucrose when received and quite a number showed considerable sediment, due in part to the fact that some of the samples were taken before cleansing or filtering and some after, and also to the settling of the flocculent sediment and to the natural deposition of the malate of lime on standing. In order to prepare the crystallized samples for analysis the sirup was poured off, water added to dissolve the crystals of sugar, the solution was added to the sirup, and the mixture boiled down to a solid content of about 65 per cent, a note being made when this was done. Analyses were made only on the clear sirups. All samples showing a sediment were decanted, and if this proved insufficient, they were filtered. This should be done in all examinations of maple sirup, as the separated material is no longer a part of the maple sirup.

The analytical examination of the samples was preceded by a physical examination. The general appearance was noted, whether crystallization had taken place or not, whether the sirup was bright or cloudy, the amount of sediment, and the color of the sirup. The analytical methods used were those prescribed in Circular 40 of the Bureau of Chemistry, with a few modifications. In brief they are as follows:

COLOR DETERMINATION.

The method for color determination was that used by this laboratory in cane sirup work. The standard colors were prepared according to the following method:

The materials used are (1) pure glycerin and (2) a caramel solution, which is prepared as follows:

Heat 6 grams of pure sugar to 212° C. for one-half hour in a flat-bottomed aluminum dish and dissolve the caramel formed in boiling water, evaporate to a small volume, and make up to 200 cc with glycerin. The oven for caramelizing the sugar (fig. 1) is constructed as follows:

A and A′ are heavy sheets of asbestos board 18 cm (7 inches) square, A′ being perforated near one edge by a hole for the cork supporting the thermometer *d*; *b* is a sheet-iron cylinder 15 cm (6 inches) in diameter; *c* is a tin can 9 cm (3½ inches) in diameter, which is filled with paraffin to within 1 cm (½ inch) of the top. This can rests on the pipestem triangle *e*. The bath or oven is supported on a tripod and is heated by two burners. One burner is so adjusted as to keep the bath at 212° C.

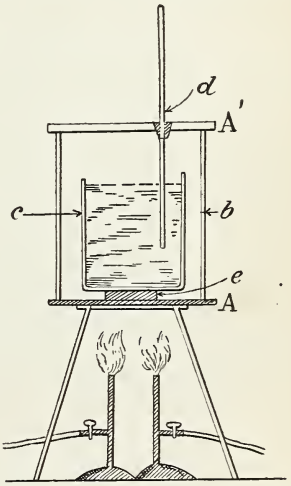

FIG. 1.—Apparatus for preparation of standard caramel.

Bring the temperature of the oven up to 212° C., using both burners. Then remove the asbestos cover carrying the thermometer and place 6 grams of sugar in a flat-bottomed aluminum dish 7 cm (2¾ inches) in diameter and 1.5 cm (⅝ inch) deep, and put it in the can containing paraffin. Replace the cover at once and as soon as the temperature reaches 208° C. turn out one burner and keep the bath at 212° C. by carefully adjusting the other one. At the expiration of thirty minutes from the time the sugar was placed in the bath, dissolve in boiling water, and make up as described. The aluminum dish should not be less than 1.5 cm (⅝ inch) deep, since the sugar melts before caramelizing and runs to one side of the dish, which, if too shallow, will tilt, fill with paraffin, and sink.

With the ingredients thus prepared, the scale of colors is made up by mixing as indicated in the following table:

Amounts of ingredients to be used in preparing solutions for the color scale.

Color No.	Caramel solution.	Glycerin.	Color No.	Caramel solution.	Glycerin.	Color No.	Caramel solution.	Glycerin.
	Grams.	*Grams.*		*Grams.*	*Grams.*		*Grams.*	*Grams.*
1	0.00	35.00	8	3.50	31.50	15	17.00	18.00
2	.25	34.75	9	4.50	30.50	16	20.00	15.00
3	.50	34.50	10	5.50	29.50	17	23.50	11.50
4	.75	34.25	11	7.00	28.00	18	27.00	8.00
5	1.00	33.00	12	8.50	26.50	19	31.00	4.00
6	1.50	33.50	13	11.00	24.00	20	35.00	.00
7	2.50	32.50	14	14.00	21.00			

The standard colors were placed in 1-ounce screw-capped vials of perfectly clear glass, having the same internal diameter. The sample to be examined was placed in a vial of the same size and the colors compared by transmitted light.

The Lovibond tintometer with brewer's scale was tried, but its use was found to complicate the determination, as with the light-colored sirups an inch cell could be used, but with the ordinary colored sirup a one-eighth inch cell was necessary and the darker colored sirups could not be read at all. It seemed best, therefore, to use these standard colors which are easily prepared, and when the caramel solution is made as prescribed an even color is obtained. An attempt has been made in the color chart (see Plate I) to reproduce these as they appear by transmitted light. This chart should be used only for an approximate determination and for relative values; for an exact classification the colors should be prepared as described and a direct comparison made.

MOISTURE.

The refractometer and the table of Geerligs [a] were used, it having been proved that this method gives results concordant with those obtained by actual drying.

POLARIZATION.

Weigh out accurately 26 grams of the sirup and transfer to a 100 cc flask (true cc) with water. (In most cases 5 cc of alumina cream were added and the contents made up to the mark. In the few instances when it was necessary to clarify with lead, 1 cc of neutral lead acetate was used.) After filling to the mark add about 1 gram of dry kaolin and shake to give a clear solution on filtering. Determine the direct polarization at 20° C. Place 50 cc of the solution in a 50 to 55 cc flask (if lead is present remove it with a small quantity of dry potassium oxalate), add 5 cc of concentrated hydrochloric acid, and allow to stand for over twenty-four hours, at the room temperature, for inversion. On the following day make polarizations at 20° and 87° C. on this solution.

In this investigation the solution was not neutralized before heating to 87° as the arrangements for conducting the determination were such that the solution was not heated for more than one or two minutes before the reading was made. Sucrose was calculated from the formula

$$S=\frac{100\ (P-I)}{142.66-\frac{T}{2}}$$

INVERT SUGAR.

Munson and Walker's method and tables [b] were used for this work. Make up 50 cc of the sugar solution required by adding 10 or 15 cc of the solution used for polarization to 35 or 40 cc of water. Weigh the precipitated red oxid as such and find the quantity of invert sugar present from the table in the column headed, "Invert sugar and sucrose, 2 grams total sugar." Allowance is thus made for the reducing effect of the sucrose on the Fehling solution. Fifteen cubic centimeters of the solution for polarizing (3.9 grams of original sirup) contain about 2.43 grams of total sugars. If the percentage of invert sugar present is not over 6 per cent, which is the case in many fresh samples, use 15 cc, but if more is present, 10 or even 5 cc should be used. When using as little as 5 cc it would be better to use the value for invert sugar found in the column headed, "Invert sugar and sucrose, 0.4 gram total sugar."

ASH DETERMINATIONS.

Total ash.—Weigh out 5 grams of the sirup in a tared platinum dish, add a few drops of pure olive oil to allay frothing, and heat the whole carefully over the direct Bunsen flame. When this is thoroughly carbonized place the dish over a low-burning

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[a] U. S. Dept. Agr., Bureau of Chemistry Cir. 43, p. 7; Bul. 122, p. 169. J. Amer. Chem. Soc., 1908, **30**:1443-51.

[b] U. S. Dept. Agr., Bureau of Chemistry Bul. No. 107, Revised, p. 241.

Bunsen flame, or better, in a muffle at a very low heat. When all carbon has disappeared, cool the dish in a desiccator and weigh quickly. Find the per cent of total ash by dividing the weight by 5 and multiplying by 100. In case the last traces of carbon are hard to burn, add a little water, evaporate, and then reheat or burn. Note the color of the ash.

Soluble and insoluble ash.—To the platinum dish containing the total ash add 40 cc of hot water and boil gently for two minutes, using care to avoid spattering. Filter through a small ashless filter and wash with hot water until the filtrate amounts to about 100 cc. Retain the filtrate for determining the alkalinity of the soluble ash. Transfer the filter paper containing the insoluble ash to the same platinum dish and carefully ash at a low red heat, as before. Cool and weigh. The increase in weight over the platinum dish is due to the insoluble ash. Divide this quantity by 5 and multiply by 100 and the percentage obtained is the *insoluble ash.* Subtract this per cent of insoluble ash from the per cent of total ash and the result is the per cent of soluble ash. Save the platinum dish with the insoluble ash for the determination of the alkalinity of insoluble ash.

Alkalinity of soluble ash.—Transfer the 100 cc of water solution from the preceding determination to a beaker or porcelain evaporating dish and determine the alkalinity by titrating with tenth-normal hydrochloric acid, using methyl orange as an indicator. The number of cubic centimeters of acid used divided by 5 gives the number of cubic centimeters of tenth-normal acid necessary to neutralize the ash of 1 gram of sample, which figure multiplied by 100 is used to express the alkalinity of the soluble ash.

Alkalinity of insoluble ash.—To the platinum dish containing the insoluble ash add an excess of tenth-normal acid (usually 5 cc) and about 30 cc of water. Heat gently until solution is complete. Cool and titrate with tenth-normal sodium hydroxid, using methyl orange as an indicator. Subtract the number of cubic centimeters of tenth-normal alkali used from the number of cubic centimeters of acid and the remainder will be the number of cubic centimeters of acid used to neutralize the insoluble ash. This number divided by 5 and multiplied by 100 gives the alkalinity of the insoluble ash.

LEAD NUMBER.

Two determinations of the lead number were made, one using the ordinary basic lead acetate solution and the other using normal or neutral lead acetate solution for the precipitation. The procedure was the same in each case.

Standard lead subacetate solution.—Boil 430 grams of normal acetate and 130 grams of litharge, for half an hour, or boil 560 grams of Horne's dry lead subacetate,[a] with 1,000 cc of water; cool the mixture; allow to settle and dilute the supernatant liquid to 1.25 specific gravity. To a measured amount of this solution add 4 volumes of water and filter if not perfectly clear. The solution should be standardized each time a set of determinations is made.[b]

Standard normal lead acetate solution.—Dissolve 82 grams of lead acetate in 1,000 cc of water. Filter, if not clear.

Description of method.—Weigh 25 grams of the sample and transfer to a 100 cc flask with water. Add 25 cc of the standard lead acetate solution (either sub or normal) and shake; fill to the mark, shake, and allow to stand at least three hours before filtering. From the clear filtrate, pipette off 10 cc to a 250 cc beaker, add 40 cc of water and 1 cc of concentrated sulphuric acid; shake and add 100 cc of 95 per cent alcohol. Let stand over night, filter on a tared Gooch crucible, wash with 95 per

[a] Unless the directions for preparing the basic lead acetate are carried out with great care and exactness it is better to use the Horne's dry lead subacetate.

[b] J. Amer. Chem. Soc., 1906, **28**: 1204.

cent alcohol, dry in a water oven, and ignite over a Bunsen burner, applying the heat gradually at first. Cool and weigh. Subtract the increase in weight of lead sulphate from the weight of the blank and multiply by the factor 27.325.[a] By the use of this factor the lead number is obtained direct without the various calculations required in the original method.

Determining lead in blank.—Transfer 25 cc of the standard lead solution to a 100 cc flask, add a few drops of acetic acid, and make up the whole to the mark with water. Shake, and use 10 cc for the determination of lead as directed in the preceding section. The use of the acid is imperative[a] in this case, as it keeps all the lead in solution, when diluted with water, as pure sugar would do. Without its use a negative lead number would be possible, especially if the blank solution were filtered.

MALIC-ACID VALUE.

Two methods were employed for this determination, that of the Association of Official Agricultural Chemists,[b] with a slight modification and the calcium acetate or Cowles method.[c]

Association method slightly modified.—Weigh 6.7 grams of the sample in a sugar dish and transfer to a 200 cc beaker with 15 cc of water. Add 2 drops of ammonium hydroxid (specific gravity, 0.90); shake, add 1 cc of a 10 per cent solution of calcium chlorid, then 60 cc of 95 per cent alcohol; cover with a watch glass and heat on the steam bath for half an hour. Allow to stand on the steam bath over night with the steam turned off. Filter the material in the beaker through good filter paper and wash the precipitate with hot 75 per cent alcohol until the filtrate measures 100 cc; dry and ignite. Add from 5 to 10 cc of tenth-normal hydrochloric acid to the ignited residue, thoroughly dissolve the lime by heating carefully to just below the boiling point; cool, and titrate the excess of acid with tenth-normal sodium hydroxid, using methyl orange as an indicator. One tenth of the number of cubic centimeters of acid neutralized by the ignited residue expresses the malic acid value. Run blanks with each set of determinations, using the same amount of reagents, ammonia, acid, etc., and subtract the result on the blank from the malic acid value obtained.

Calcium acetate or Cowles method.—Weigh 6.7 grams of the sample in a sugar dish. Transfer to a 200 cc beaker with 5 cc of water. Add 2 cc of a 10 per cent calcium acetate solution and shake. Stir in 100 cc of 95 per cent alcohol and agitate the solution until the precipitate settles, leaving the supernatant liquid clear. Filter off the precipitate and wash with 75 cc of 85 per cent alcohol. Dry the filter paper and ignite in a platinum dish. Add 10 cc of tenth-normal hydrochloric acid and warm gently until all the lime dissolves. Cool and titrate back with tenth-normal sodium hydroxid, using methyl orange as an indicator. One-tenth of the number of cubic centimeters of tenth-normal acid is the malic acid number. Run a blank determination as in the other method and subtract the result obtained from the malic acid number.

TANNIN.

To 5 cc of a solution of equal parts of maple sirup and water in a test tube add 1 cc of ferric chlorid solution. The iron solution generally floats. Shake a little, a black ring or blackening of solution indicates tannin.

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[a] U. S. Dept. Agr., Bureau of Chemistry Cir. 53.

[b] U. S. Dept. Agr., Bureau of Chemistry Bul. 107, Revised, p. 74.

[c] J. Amer. Chem. Soc., 1908, **30**: 1285.

TABULATION OF DESCRIPTIVE DATA AND RESULTS OF EXAMINATION.

The results of the analysis of the samples are given in the table on page 20, the samples being designated by the serial number. The results are arranged by States and counties and the location of the county in the State is designated by the usual symbols, namely, □ center of the State, ⊡ north of center, ⊡ southeast of center, etc. The date of the opening of the sugar season and the average length of the season are given in a general way, but these figures, of course, vary somewhat in different years. The approximate number and the variety of trees tapped are also stated. The sap data include the amount of sap (expressed either in gallons or its equivalent as pounds of maple sugar) that can be obtained from a tree during the average season; also the number of gallons of sap necessary to make 1 gallon of sirup. The manufacturing data describe the kind of bucket (whether uncovered or covered), the method of evaporation (whether in pan, kettle, or evaporator), the method of cleansing, and the run from which the sample was taken. The results of the physical and chemical examination, together with the polarization data, complete the table. The figures for the lead number, malic acid value, and ash have been calculated to dry substance for better comparison and are given in the table beginning on page 67. Averages have been determined for the samples from the individual States, from Canada, and from the United States as a whole, as well as for all of the samples collected. The bracketed data in the ninth column of the table, headed "run," refer to samples from the same maker.

Tabulated results of maple sirup investigation, including camp

INDIANA.

(Season February 15 to April 1.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Clinton County: □								
6493		Hard			Uncovered wood.	Patent	Settle	Middle.
6495		do			do	do	do	
6496		do		45	do	do	do	
6497		do		40–45	Uncovered metal.	Kettle	do	1908.
6492		do		40–45	do	do	do	Middle.
6494		do		40	do	Iron pan	do	
Hendricks County: □								
6246	280	do	20	45	Uncovered wood and metal.	do	Strain and settle.	First.
6247	350	do	20	40	do	Patent	do	do.
6248	160	do	20	40	do	do	do	do.
Huntington County: □								
6323		do	8–10	35	Uncovered galvanized iron.	Iron pan	Settle and strain.	do.
6474		do						
Madison County: □								
6398		do		32	Uncovered wood.	Kettle	Eggs and milk.	Middle.
6396		do		65	do	Patent	Strain and settle.	First.
6397		do		65	do	do	do	Last.
6395		do		30–35	Uncovered metal.	Kettle	Eggs and milk.	do.
6399		do		30–35	Uncovered wood.	Tin pan	do	do.
Putnam County: □								
6239	400	do	20	40–45	Uncovered wood and tin.	Patent	Strain	First.
6240	800	do	20	40	do	do	do	do.
6241	350	do	20	40	Covered wood.	do	do	do.
6242	350	do	20	33	do	do	do	do.
6243	600	do	20	40	Uncovered wood and metal.	do	do	do.
6245	400	Rock	20	50	Covered galvanized iron.	do	do	do.
6244	250	Hard	20	50	Uncovered galvanized iron.	Iron pan	do	do.
Average (23)								
Maximum								
Minimum								

and manufacturing data, physical properties, and chemical analyses.

INDIANA.

(Season February 15 to April 1.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
9	Cloudy..	.....	31.05	63.62	1.97	0.68	2.68	+62.80	−21.60	0	None..	6493
12	Clear....	Burnt.....	33.91	62.79	1.88	.69	.73	+61.30	−22.00	0	Slight.	6495
13	Cloudy..	Strong.....	38.36	54.03	5.85	.77	.99	+51.10	−20.57	0	...do...	6496
16	Clear....	.....do.....	35.88	57.18	5.05	.67	1.22	+54.30	−21.56	0	Strong	6497
10	...do....	.....	32.00	59.95	4.61	.60	2.84	+58.50	−21.00	0	None..	6492
12	...do....	.....	38.15	50.66	6.15	1.04	4.00	+49.60	−17.60	0	...do...	6494
11	...do....	Burnt.....	33.26	61.54	2.16	1.02	2.02	+59.20	−22.44	0	...do...	6246
13	Cloudy..	Strong.....	29.51	63.71	4.17	.78	1.83	+60.10	−24.42	.....	...do...	6247
9	Clear....	Good.....	31.51	63.05	4.25	.66	.53	+60.65	−22.99	0	...do...	6248
9	...do....	Mild.....	37.31	61.33	.53	.76	.07	+59.30	−22.06	0	...do...	6323
8	.....	.....	32.35	64.05	1.19	.75	1.66	+62.90	−22.00	0	...do...	6474
16	Cloudy..	Fermented .	36.44	54.40	5.92	.98	2.26	+51.50	−20.60	0	...do...	6398
8+	...do....	Fair.....	32.23	65.10	1.23	.74	.70	+64.00	−22.40	0	...do...	6396
9+	...do....	.....do.....	33.78	62.20	1.95	.83	1.24	+60.30	−22.20	−0.4	...do...	6397
11+	Clear....	Moldy.....	37.04	58.80	1.68	.84	1.64	+56.80	−21.20	0	...do...	6395
12	...do....	Fair.....	39.04	55.70	2.38	1.01	1.87	+53.90	−20.00	0	...do...	6399
8	...do....	Good.....	41.82	55.99	1.03	.73	.43	+54.25	−20.02	0	...do...	6239
9	...do....	.....do.....	35.42	61.98	1.14	.69	.77	+60.00	−22.22	0	...do...	6240
8	Cloudy..	.....do.....	31.51	64.47	2.13	.72	1.17	+62.10	−23.43	0	...do...	6241
12	Clear....	Burnt.....	29.51	61.49	7.00	.70	1.30	+57.70	−23.87	.....	...do...	6242
12	...do....	.....do.....	30.36	60.12	7.69	.74	1.09	+56.00	−23.76	.....	...do...	6243
8	Cloudy..	.....do.....	31.21	66.12	.86	.60	1.21	+64.50	−23.21	0	...do...	6245
7	...do....	Strong.....	29.41	68.60	.50	.64	.85	+66.70	−24.31	0	...do...	6244
10+	.....	.....	33.96	60.73	3.10	.77	1.44	+58.57	−21.98	.....	.....	
16	.....	.....	41.82	68.60	7.69	1.04	4.00	+66.70	−24.42	−0.4	.....	
7	.....	.....	29.41	50.66	.50	.60	.07	+49.60	−17.60	0.0	.....	

Tabulated results of maple sirup investigation, including camp and

MAINE.

(Season March 20 to May 1.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Franklin County: ◻								
6698		Soft			Rusty metal.	Patent	Settle	Last
6695		Rock			Uncovered metal.	do	Filter and settle.	do
6696		do			do	do	do	Middle
6697		do			do	do	Eggs and milk.	do
Oxford County: ◻								
6694		Hard		60–75	do	do	Strain and settle.	
6693		Soft		60–75	do	Iron pan	Strain	Middle
6692		do		60–75	do	do	do	do
Penobscot County: ◻								
6713		Hard and soft.		50–60	Uncovered metal and wood.	Kettle	do	do
6714		do		50–60	Uncovered metal.	do	do	do
Average (9)								
Maximum								
Minimum								

MASSACHUSETTS.

(Season March 1 to April 15.)

Berkshire County: ◻								
6574		Rock			Uncovered metal.	Patent	Strain	
6573		do			do	do	do	
6572		do			do	do	do	
Franklin County: ◻								
6616		Hard		40–50	do	Iron pan	Strain and settle.	
6613		do		40–50	do	Patent	do	
6615		do		40–50	Uncovered wood.	do	do	
6614		do		40–50	Uncovered wood and metal.	do	do	
Hampden County: ◻								
6505		do		50	Uncovered wood.	Iron pan	Milk and eggs.	
6504		do		45	do	do	Strain and settle.	
6506		do		50	do	do	do	
Average (10)								
Maximum								
Minimum								

manufacturing data, physical properties, and chemical analyses—Continued.

MAINE.

(Season March 20 to May 1.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
13	Clear....	Strong.....	33.72	58.68	4.79	0.90	1.91	+55.40	−22.44	0	Slight.	6698
8	Cloudy..	Mild.....	31.10	66.17	.46	.83	1.44	+63.80	−23.98	0	None..	6695
7	...do.....	Buddy.....	30.21	68.08	.41	.63	.67	+66.00	−24.31	0	...do...	6696
7	...do.....	Mild.....	35.82	60.47	1.18	.80	1.73	+58.00	−22.22	0	...do...	6697
8+	...do	.....do.....	33.10	65.43	.62	.62	.23	+63.70	−23.10	0	...do...	6694
12	Clear.....	.....do.....	33.23	66.26	.36	.64	.....	+64.80	−23.10	0	...do...	6693
14	...do.....	Burnt.....	32.67	65.28	1.73	.68	.....	+63.60	−22.99	0	Slight.	6692
8	...do	Good.....	33.02	63.66	.45	.85	2.02	+60.80	−23.65	−1.5	None..	6713
9	...do.....	Mild.....	36.62	61.60	.56	.61	.61	+59.60	−22.11	0	...do...	6714
8+	.....	.....	33.27	63.96	1.17	.73	.87	+61.75	−23.10	.....	.....	
14	.....	.....	36.62	68.08	4.79	.90	2.02	+66.00	−24.31	.....	.....	
7	.....	.....	30.21	58.68	.36	.61	.00	+55.40	−22.11	.....	.....	

MASSACHUSETTS.

(Season March 1 to April 15.)

8	Cloudy..	Mild.....	34.51	61.55	1.96	0.62	1.36	+60.75	−20.90	0	None..	6574
7	...do.....	.....do.....	37.36	60.45	.48	.51	1.20	+59.85	−20.35	0	...do...	6573
7	...do	Burnt.....	30.88	65.84	.66	.57	2.05	+65.45	−21.89	0	...do...	6572
7	...do.....	Good.....	28.21	70.19	.53	.66	.41	+68.70	−24.42	0	...do...	6616
8	...do.....	.....do.....	32.08	66.27	.97	.60	.08	+64.70	−23.16	0	...do...	6613
8	...do.....	Fair.....	40.52	57.41	.70	.76	.61	+56.70	−19.46	0	...do...	6615
8	...do.....	Good.....	36.49	62.01	.53	.55	.42	+60.23	−22.03	0	...do...	6614
6	...do.....	Fair.....	28.21	70.05	1.09	.69	.....	+68.40	−24.53	0	...do...	6505
6	...do.....	.....	33.18	64.59	.79	.75	.69	+63.25	−22.44	0	...do...	6504
6	Turbid..	Mild.....	31.85	66.56	.65	.68	.28	+65.20	−23.10	0	...do...	6506
7	.....	.....	33.33	64.49	.84	.64	.70	+63.32	−22.23	.....	...do...	
8	.....	.....	40.52	70.19	1.96	.76	2.05	+68.70	−24.53	0	...do...	
6	.....	.....	28.21	57.41	.48	.51	.00	+56.70	−19.46	0	...do...	

Tabulated results of maple sirup investigation, including camp and

MICHIGAN.

(Season March 1 to May 1.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Branch County:								
6451	.....	Hard	16	32	Uncovered tin.	Iron pan	Strain and settle.	First[a]
Eaton County:								
6461	.....	do	15	40	Uncovered metal.	do	Eggs and milk.	First
6462	.....	do	12–20	40	do	Patent	Settle	do
6463	.....	do	.....	25	Covered tin	Iron pan	Eggs and milk.	do
Ingham County:								
6453	150	do	.....	32	Uncovered metal.	do	do	do
6454	2,000	do	12	30–35	Covered tin	Patent	Eggs	First
6455	2,000	do	12	30–35	do	do	do	Last[a]
6444	.....	do	.....	32–50	Uncovered metal.	Iron pan	Milk	.....
6456	400	do	10–20	40	do	Patent	Eggs and milk.	First[a]
6452	.....	do	25–50	40–50	do	Kettle	do	First
Ionia County:								
6473	.....	do	10–25	35	Uncovered wood and metal.	Iron pan	Strain and settle.	do
6477	.....	do	4	50	do	do	do	do
6475	.....	do	10	50	Covered tin	Patent	do	.....
Kent County:								
6516	.....	do	20–50	35	Uncovered wood.	Copper	do	First
6517	.....	do	8–12	32–48	Uncovered tin.	Iron pan	Eggs and milk.	do
6515	.....	do	25	50–75	Covered tin	Patent	Strain and settle.	do
6514	.....	do	20	40–50	Uncovered tin.	do	do	.....
Lenawee County:								
6450	300	do	12–20	40–60	Uncovered wood and tin.	do	Eggs and milk.	First[a]
6322	.....	do	14	45	Uncovered metal.	do	do	do
Ottawa County:								
6491	.....	do	10–15	32	do	do	Milk	First
6490	.....	do	10–30	40	do	do	Strain and settle.	.....
6513	.....	do	.....	30	Uncovered wood and metal.	Iron pan	do	Middle
6512	.....	do	25–30	40	Uncovered metal.	do	Eggs and milk.	(a)
Average (23)	.....	.....	.....	.....	.....	.....	.....	.....
Maximum	.....	.....	.....	.....	.....	.....	.....	.....
Minimum	.....	.....	.....	.....	.....	.....	.....	.....

[a] Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

MICHIGAN.

(Season March 1 to May 1.)

Physical properties.			Chemical analysis.					Polarizations.				
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20°C.).	Invert. At 20° C.	Invert. At 87° C.	Tannin reaction.	Serial number.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
5+	Clear....	Good.....	34.62	63.66	1.26	0.60	.....	+61.90	−22.55	0	None..	6451
8	Cloudy..	Mild.....	36.75	61.20	.78	.65	0.62	+59.30	−21.89	0	...do..	6461
9	...do....	.....do.....	37.05	61.17	.81	.56	.41	+59.70	−21.45	0	...do..	6462
9	Clear....	.....do.....	37.85	59.73	1.07	.62	.73	+57.90	−21.34	0	...do..	6463
12+	...do....	Strong.....	31.53	63.10	4.77	.55	.05	+60.50	−23.21	0	Slight.	6453
7	Cloudy..	Mild.....	31.95	66.71	.40	.56	.38	+65.40	−23.10	0	None..	6454
12	Clear....	Good.....	35.06	61.47	1.64	.75	1.08	+58.45	−23.10	0	...do..	6455
11	...do....	.....do.....	36.08	62.15	.43	.63	.71	+61.00	−21.45	0	...do..	6444
7	...do....	.....do.....	38.82	59.79	1.39	.62	.....	+58.20	−21.12	0	...do..	6456
13	...do....	Strong.....	34.13	60.49	3.64	1.06	.68	+58.40	−21.84	0	Slight.	6452
11	.....	.....	29.80	61.30	5.95	.60	2.35	+59.30	−22.00	0	None..	6473
9	.....	.....	36.15	58.25	3.03	.79	1.78	+57.20	−20.00	0	...do..	6477
9	.....	.....	31.60	62.10	3.12	.63	2.55	+61.40	−21.00	0	...do..	6475
8	Cloudy..	Peculiar....	35.03	61.62	1.93	.69	.73	+59.30	−22.44	0	...do..	6516
10	...do....	Strong.....	32.10	64.09	2.41	.63	.77	+62.00	−22.99	0	...do..	6517
8	Turbid..	Mild.....	35.68	62.54	.71	.62	.45	+60.90	−22.06	0	...do..	6515
8	...do....	.....do.....	33.98	62.94	1.72	.54	.82	+60.50	−22.99	0	...do..	6514
7	Clear....	Good.....	35.81	62.78	1.00	.64	.....	+61.20	−22.11	0	...do..	6450
8	...do....	Mild.....	30.39	66.04	2.59	.58	.40	+63.30	−24.31	0	...do..	6322
10	.....	.....	31.15	61.06	4.14	.65	3.00	+60.60	−20.40	0	...do..	6491
7+	.....	.....	37.35	59.20	.89	.65	1.91	+58.90	−19.60	0	...do..	6490
10	Turbid..	Strong.....	36.18	59.22	3.04	.69	.87	+57.00	−21.56	0	Slight.	6513
8	Clear....	Good.....	39.02	59.18	1.00	.54	.26	+57.40	−21.12	0	None..	6512
8+	.....	.....	34.69	61.73	2.07	.65	.86	+59.99	−21.89	.....	.....	.....
13	.....	.....	39.02	66.71	5.95	1.06	3.00	+65.40	−24.31	.....	.....	.....
5+	.....	.....	29.80	58.25	.40	.54	.00	+57.00	−19.60	.....	.....	.....

Tabulated results of maple sirup investigation, including camp and

NEW HAMPSHIRE.

(Season March 10 to May 1.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Cheshire County:								
6658		Hard		40–50	Uncovered metal.	Patent	Settle	Last
6657		do		40–50	Covered wood.	do	do	
6659		Rock		40–50	Uncovered wood.	Iron pans	do	
Hillsboro County:								
6655		Hard		40–50	Covered metal.	Patent	Strain and settle.	(a)
6656		do		40–50	do	do	do	(a)
Grafton County:								
6681		Rock		45	Uncovered tin.	do	do	Middle
6682		do		45	do	do	do	do
6673		do		45	Uncovered wood and metal.	do	do	do
6671		Hard		45	Uncovered wood.	Iron pans	do	do
6672		do		45	Uncovered wood and metal.	Patent	do	do
6683		do		45	Uncovered tin.	do	do	do
6670		Rock		45	Uncovered wood.	do	do	do
Sullivan County:								
6680		do		40–45	Covered metal.	do	Settle and strain.	First
6675		do		50	Uncovered metal.	do	do	Middle
6674		do		50	do	do	do	Last
Average (15)								
Maximum								
Minimum								

NEW YORK.

(Season March 1 to April 15.)

Allegany County:								
6525		Hard			Uncovered metal.	Patent	Strain and settle.	
6524		do			Uncovered tin and wood.	do	do	
6523		do			Uncovered tin.	Iron pans	do	
Cattaraugus County:								
6530		do	12–16	32	Uncovered metal.	Patent	Sweet milk	
6528		do		30	do	do	Eggs and milk.	First
6527		do	20	40	do	Iron pan	Strain and settle.	(a)
6529		do	15	30–45	do	Patent	do	
6526		do			do	Iron pan	Eggs and milk.	(a)

a Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

NEW HAMPSHIRE.

(Season March 10 to May 1.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
12	Clear....	Strong....	38.13	58.61	1.29	0.58	1.36	+56.30	−21.45	0	None..	6658
4	Cloudy..	Woody....	42.11	56.28	.38	.58	.65	+55.30	−19.36	0	...do..	6657
8	...do....	Fair.....	38.13	59.72	.80	.69	.66	+58.00	−21.23	0	...do...	6659
7	Clear....	Mild.....	35.82	63.24	.27	.71	.....	+61.45	−22.44	0	...do...	6655
5	...do....	.....do....	43.37	55.65	.24	.59	.15	+54.80	−19.03	0	...do...	6656
8	Cloudy..	Fair.....	32.45	65.84	.33	.54	.84	+63.75	−23.59	0	...do...	6681
9	...do....	....do....	34.60	63.85	.33	.61	.61	+62.15	−22.55	0	...do...	6682
7	...do....	Buddy...	33.22	64.70	.26	.53	1.29	+62.40	−23.43	0	...do...	6673
11	..do....	Rank.....	33.72	63.55	.54	.67	1.52	+61.10	−23.31	0	...do...	6671
9	Clear....	Buddy....	32.51	64.79	.46	.63	1.61	+62.80	−23.15	0	...do...	6672
8	Cloudy..	Good....	33.30	64.77	.39	.55	.99	+63.15	−22.77	0	...do...	6683
8+	...do....	.....do....	35.56	61.49	1.05	.61	1.29	+59.35	−22.22	0	...do...	6670
5	...do....	Peculiar...	32.50	66.57	.19	.46	.28	+65.05	−23.26	0	.. do	6680
11	Clear...	Strong....	43.34	54.20	.40	.55	1.51	+52.65	−19.25	0	..do...	6675
9	Cloudy..	.....do.....	35.88	61.21	1.72	.66	.53	+59.20	−22.00	0	..do...	6674
8	.....	.....	36.31	61.63	.58	.59	.89	+59.83	−21.94	....	.....	.....
12	.....	.....	43.37	66.57	1.72	.71	1.61	+65.05	−23.59	....	.....	.....
4	.....	.....	32.45	54.20	.19	.46	.00	+52.65	−19.03	....	.....	.....

NEW YORK.

(Season March 1 to April 15.)

5+	Cloudy..	Woody.....	35.42	63.07	0.56	0.56	0.39	+62.00	−21.67	0	None..	6525
9	...do....	Strong.....	31.72	65.81	2.03	.59	.....	+64.10	−23.21	0	...do...	6524
6	...do....	Mild.....	41.97	56.51	.75	.52	.25	+55.60	−19.36	0	..do...	6523
11	Turbid..	Burnt.....	32.52	64.72	2.55	.57	.....	+62.10	−23.76	0	Slight.	6530
8	...do....	Good.....	32.52	65.85	1.08	.55	.06	+64.70	−22.66	0	None..	6528
7+	Clear....	.....do.....	28.46	68.97	1.41	.56	.60	+67.30	−24.20	0	...do ..	6527
8+	Cloudy..	.....do.....	32.97	64.56	1.13	.60	.73	+63.10	−22.55	0	...do ..	6529
6	Clear....	.....do.....	28.11	70.37	1.10	.59	.....	+68.60	−24.75	0	...do ..	6526

Tabulated results of maple sirup investigation, including camp and

NEW YORK—Continued.

(Season March 1 to April 15.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Chautauqua County: □								
6537	500	Hard		48	Covered tin	Iron pan	Eggs and milk.	
6538	300	do	20	26	do	do	do	
6535		do	20	50	do	do	do	
6583		do	15	47	do	do	Milk and saleratus.	
6585	500	do	20	35	do	Steam	Milk	
6581	500	do		47		Steam coil.	Settle and strain.	
6575	400	do	16	52	Covered tin	Tin vat steam.	do	(a)
6539	500	do	11	47	do	Iron pan	Eggs and milk.	
6588	500	do		40	do	Patent	do	
6533	275	do		43	Uncovered tin.	Iron pan	do	(a)
6592	500	do		35	Covered wood and metal.	do	do	
6589	600	do	20	40		Iron steam	do	
6536	500	do		35	Covered tin	Patent	Milk	
6587	1,100	do				Iron pan	Settle and strain.	(a)
6591	400	do			Uncovered tin.	Patent	Eggs and milk.	(a)
6576	400	do		40	Covered tin	Tin vat	Settle and strain.	(a)
6578		do		32	do	Iron pans.	Lard and milk.	
6404	275	do	15	35–40	do	do	Milk	
6582	600	do		32	Covered tin and wood	Iron pan	Eggs and milk.	
6415	800	do	18	32	Covered tin	Patent	Settle and skim.	Second.
6593	140	do	17	32	Covered metal.	Iron pan	Milk	
6531		do		32	Uncovered tin.	do	Eggs and milk.	
6584	150	do		30	Covered tin	Iron steam	Milk	(a)
6594	260	do	19	40	do	Iron pan	Eggs and milk.	
6579	300	do		40	do	do	Milk	(a)
6532		do		32	do	do	Settle and strain.	
6590	1,100	do		32		Vat steam	Egg and milk.	
6580	300	do	21	47–48	Uncovered tin.	Iron pan	Milk	(a)
6577	800	d9		31–47	Covered tin	Patent	Milk and soda.	
6586	1,000	do		40	do		Settle and strain.	(a)
Chenango County: □								
6502	900	do	30	30	Uncovered tin.	do	Milk and eggs.	(a)
6503	500	do	30	30	Uncovered wood and tin.	Iron pans.	Settle	
Cortland County: □								
6501	400	do	30	30	do	Iron pan	Eggs and milk.	(a)
6540	300	do	30	30	Uncovered tin.	do	Milk and settle.	(a)
6470	600	do	30	30	Uncovered wood.	Patent	Settle and milk.	Not clarified.
6471	600	do	30	30	do	do	do	Clarified.

(a) Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

NEW YORK—Continued.

(Season March 1 to April 15.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
6	Cloudy..	Fair.....	37.10	61.40	0.33	0.59	0.58	+60.60	−20.80	0	None .	6537
7	Clear....	Good.....	34.10	64.60	.24	.57	.49	+63.50	−22.20	— .2	...do ..	6538
9	Cloudy..	Fair.....	31.60	64.90	1.30	.72	1.48	+64.00	−22.00	— .4	...do ..	6535
7	...do....	Good.....	30.60	67.31	.23	.68	1.18	+66.90	−22.40	0	...do ..	6583
8	...do....	.....do.....	33.15	64.68	.36	.75	1.06	+64.20	−21.60	0	...do ..	6585
9	...do....	Fair.....	29.00	64.90	3.68	.61	1.81	+63.30	−22.80	0	...do ..	6581
6+	Clear....	Good.....	33.66	65.57	.48	.63	.....	+64.00	−22.99	0	...do ..	6575
8	Cloudy..	.....do.....	32.35	65.10	.97	.72	.86	+64.00	−22.40	0	...do ..	6539
7	Clear....	Fair.....	32.65	65.35	.20	.55	1.25	+64.90	−21.80	0	...do ..	6588
7+	Cloudy..	Good.....	26.96	70.46	1.80	.76	.02	+68.50	−24.97	0	...do ..	6533
11	Clear....	Strong.....	33.00	61.81	2.72	.69	1.78	+60.60	−21.40	0	...do ..	6592
8	...do....	.....do.....	31.75	65.58	.65	.64	1.38	+64.80	−22.20	0	...do ..	6589
8	...do....	Moldy.....	31.85	65.90	1.10	.66	.49	+64.70	−22.60	0	...do ..	6536
6+	...do....	Good.....	39.93	58.25	.64	.56	.62	+56.70	−20.57	0	...do ..	6587
6+	...do....	.....do.....	40.98	57.37	.42	.55	.68	+55.70	−20.41	0	...do ..	6591
7	...do....	.....do.....	37.51	61.87	.46	.58	.....	+60.30	−21.78	0	...do ..	6576
9	Cloudy..	.....do.....	32.70	65.36	.34	.56	1.04	+65.30	−21.40	0	...do ..	6578
6	...do....	Moldy.....	36.64	62.10	.37	.54	.35	+61.20	−21.20	0	...do ..	6404
7	Clear....	Good.....	32.45	65.13	.18	.63	1.61	+64.80	−21.60	0	...do ..	6582
7	Cloudy..	Fair.....	36.07	62.40	.53	.64	.36	+62.00	−21.40	0	...do ..	6415
7	...do....	.....do.....	29.25	67.92	.52	.86	1.45	+67.50	−22.60	0	...do ..	6593
7+	...do....	.....do.....	31.02	67.59	.64	.57	.18	+65.80	−23.87	0	...do ..	6531
6	Clear....	Good.....	40.57	58.31	.38	.54	.20	+56.40	−20.96	0	...do ..	6584
7	...do....	Woody.....	34.35	63.24	.47	.67	1.27	+62.90	−21.00	0	...do ..	6594
6	...do....	Good.....	36.42	62.06	.91	.59	.02	+60.00	−22.33	0	...do ..	6579
6+	...do....	Fair.....	32.17	65.92	.98	.63	.30	+64.30	−23.15	0	...do..	6532
7	Cloudy..	.....do.....	34.55	62.79	.44	.78	1.44	+62.30	−21.00	0	...do ..	6590
7	Clear....	Good.....	42.62	55.78	.59	.51	.50	+54.20	−19.80	0	...do ..	6580
9	...do....	Woody.....	30.16	68.09	.50	.56	.69	+67.50	−22.83	0	...do ..	6577
9	...do....	Strong.....	31.90	65.51	.60	.62	1.37	+64.90	−22.00	0	...do ..	6586
7	...do....	Good.....	28.81	70.42	.60	.71	.....	+69.00	−24.42	0	...do...	6502
7	Cloudy..	Mild.....	39.18	58.93	.61	.61	.67	+57.60	−20.57	0	...do...	6503
9	...do....	Fair.....	27.21	70.07	.77	.70	1.25	+68.20	−24.75	0	...do ..	6501
7	Clear....	Good.....	34.21	64.90	.26	.50	.13	+63.00	−23.10	0	...do...	6540
7	Cloudy..	Fair.....	36.50	61.77	.56	.62	.55	+60.50	−21.45	0	...do...	6470
7	Clear....	.....do.....	35.55	61.80	2.42	.67	.....	+61.20	−20.80	0	...do...	6471

Tabulated results of maple sirup investigation, including camp and

NEW YORK—Continued.

(Season March 1 to April 15.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Cortland County □ — Continued.								
6543	900	Hard	30	30	Uncovered tin.	Patent	Milk	Open buckets.
6544	900	do	30	30	do	do	do	Closed buckets.
6464	900	do	30	30	do	do	Settle	Not clarified.
6465	900	do	30	30	do	do	do	Clarified.
6478	400	do	30	30	Uncovered wood.	Iron pans.	Milk	(a)
6541	800	do	30	30	Covered tin	Patent	do	Not clarified.
6542	800	do	30	30	do	do	do	Clarified.
Delaware County: ◻								
6631	2,000	do	30	30	Uncovered tin and wood.	Iron pan	Eggs and milk.	Third[a]
6629	500	Hard and soft.	35	30	do	do	Milk	Clarified.
6630	500	do	35	30	do	do	do	Not clarified.
6628	600	Hard	30	30	Uncovered tin.	do	Eggs and milk.	(a)
6627	600	do	30	30	do	do	do	(a)
Lewis County: ◻								
6565	6,000	do	30	30	Uncovered wood and tin.	Patent	Strain and settle.	First[a]
6568	6,000	do	30	30	do	do	do	Middle
6571	1,800	do	30	30	do	Iron pans.	do	
6569	800	do	30	30	do	do	do	(a)
6570	900	do	30	30	do	Patent	do	
6564	9,000	do	30	30	Uncovered tin.	do	do	
6567	3,000	do	30	30	do	do	do	
6566	2,000	do	30	30	Uncovered wood and tin.	Iron pans.	do	
Wyoming County: ◻								
6521	800	do		40	Uncovered galvanized iron.	do	do	
6522		do	20	50	Uncovered wood.	do	do	(a)
Average (66)								
Maximum								
Minimum								

OHIO.

(Season February 20 to April 10.)

Ashtabula County: □								
6647	450	Hard	18	48	Covered tin.	Patent	Strain and settle.	First
6440	625	Hard and soft.	10–20	32–48	do	do	do	First
6973	625	do	10–20	32–48	do	do	do	Last[a]
6441	500	Hard	16–20	32–36	do	Iron pan	do	First
6442	1,000	do	36	48–64	do	Patent	do	First
6443	1,000	do	36	48–64	do	do	do	(a)
6992	1,000	do	36	48–64	do	do	do	Last

[a] Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

NEW YORK—Continued.

(Season March 1 to April 15.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
6+	Cloudy..	Fair.....	29.75	68.60	0.32	0 73	0.60	+67.40	−23.60	0	None..	6543
6	...do.....	.....do.....	32.90	66.20	.17	.59	.14	+65.40	−22.40	0	...do...	6544
7	Clear....	Good.....	32.96	65.33	.36	.62	.73	+63.90	−22.77	0	...do...	6464
7+	...do.....	Mild	32.80	65.79	.47	.62	.32	+64.40	−22.88	0	...do...	6465
8	...do.....	Good.....	35.86	62.56	1.19	.63	.....	+60.45	−22.55	0	...do...	6478
8	...do.....	Fair.....	30.40	67.50	.17	.66	1.27	+66.50	−23.00	0	...do...	6541
8	...do.....	Poor.....	31.30	67.00	.17	.77	.76	+66.10	−22.80	0	...do...	6542
7	Cloudy..	Mild.....	43.80	53.20	.89	.54	1.57	+52.10	−18.40	0	...do...	6631
7	Clear....	.....do.....	41.67	55.71	.63	.55	1.44	+54.10	−19.80	0	...do...	6629
8	Cloudy..	Strong.....	31.30	66.50	.41	.63	1.16	+64.60	−23.60	.....	...do...	6630
5	...do.....	Mild.....	38.55	59.17	.53	.52	1.23	+57.70	−20.79	0	...do...	6628
5	Clear....	.....do.....	37.13	59.13	2.31	.71	.72	+57.10	−21.34	0	...do...	6627
7	...do.....	Good.....	36.46	62.59	.60	.54	.....	+60.70	−22.33	0	...do...	6565
7	Cloudy..	.....do.....	31.01	66.02	.86	.54	1.57	+65.30	−22.28	0	...do...	6568
9	...do.....	Woody.....	33.48	63.90	.49	.59	1.54	+63.10	−21.67	0	...do...	6571
8	Clear....	Good.....	32.81	65.21	.79	.60	.59	+63.30	−23.21	0	...do...	6569
9	Cloudy..	Fair.....	32.03	65.88	.64	.56	.89	+64.30	−23.10	0	...do...	6570
8	...do.....	Good.....	31.41	64.01	1.40	.59	2.59	+62.80	−22.11	0	...do...	6564
8	...do.....	.....do.....	34.38	62.63	.94	.53	1.52	+61.75	−21.34	0	...do...	6567
8	...do.....	Mild.....	31.58	65.89	.65	.58	1.30	+64.90	−22.51	0	...do...	6566
8	...do.....	.....do.....	35.02	63.26	.60	.64	.48	+62.10	−21.89	0	...do...	6521
9+	...do.....	Good.....	29.61	69.12	1.21	.63	.....	+67.50	−24.20	0	...do...	6522
7	.....	.....	33.76	64.09	.83	.62	.70	+62.85	−22.18	.....	.....	
11	.....	.....	43.80	70.46	3.68	.86	2.59	+69.00	−24.97	.....	.....	
5	.....	.....	26.96	53.20	.17	.50	.00	+52.10	−18.40	.....	.....	

OHIO.

(Season February 20 to April 10.)

6	Cloudy..	Fair.....	32.26	66.37	0.61	0.62	0.14	+64.40	−23.65	0	None .	6647
9	...do.....	Mild.....	32.91	63.40	.96	.65	2.08	+63.00	−21.20	−2.0	...do...	6440
6+	...do.....	.....do.....	36.82	55.08	5.49	.61	2.00	+51.40	−21.67	.....	...do...	6973
8	...do.....	.....do.....	32.91	64.70	.36	.65	1.38	+64.30	−21.60	−1.8	...do...	6441
8	...do.....	.....do.....	31.90	65.50	.27	.68	1.65	+64.90	−22.00	−1.2	...do...	6442
6	...do.....	.....do.....	31.73	66.28	.45	.63	.91	+65.05	−22.88	0	...do...	6443
5	Clear....	.....do.....	33.19	63.81	1.44	.56	1.00	+62.10	−22.55	0	...do...	6992

Tabulated results of maple sirup investigation, including camp and

OHIO—Continued.

(Season February 20 to April 10.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Champaign County:								
6309		Hard		45	Uncovered wood and tin.	Kettles	Strain and settle.	
6391		do	20	40–45	Uncovered wood.	Iron pans	Strain	Last
6392		do		40	do	Kettles	Eggs and milk.	do
6310		do		50	do	do	Strain and settle.	Middle
6393		do		45	do	do	Milk and soda.	do
6308		do	15	40	Uncovered wood and tin.	Patent	Strain	do
6400		do		47	Uncovered wood.	Iron pan	do	Last
6401		do		40–45	do	Kettles	Eggs and milk.	do
Cuyahoga County:								
6366	700	do	18	48	Covered tin	Iron pan	Strain and settle.	First[a]
6985	700	do	18	48	do	do	do	Last
6364	800	do	18	24	Uncovered galvanized iron.	Patent	do	First
6365	1,200	do	15	32	do	do	do	First
6986	1,200	do	15	32	Uncovered tin.	do	do	Last
6363	550	do	30	32	do	do	do	First[a]
6975	550	do	30	32	do	do	do	Last
Geauga County:								
6369	2,400	do	10	30	Covered tin	do	do	First
7018	2,400	do	10	30	do	do	do	Last
6379	1,600	do	15	44	do	do	do	First
6987	1,600	do	15	44	do	do	do	Last
6970	1,400	do	8	40	do	do	do	First
6977	1,400	do	8	40	do	do	do	Last
6375	4,000	do	16	38–40	do	do	do	Middle
6380	600	do	13–14	37	Uncovered iron and tin.	do	do	Middle
6981	600	do	13–14	37	do	do	do	Last
6367	1,000	Hard and soft.	10	32	Uncovered tin.	do	Milk	First
6991	1,000	do	10	32	do	do	do	Last
6372	800	Hard	10	35	Covered painted wood.	do	Strain and settle.	Middle
6982	800	do	10	35	do	do	do	Last
6381	900	do	15	35–40	Covered tin.	do	do	Middle
6376	800	do	8	32	Covered iron.	do	do	First
6368	4,800	do	8	32	Covered tin.	do	do	do
6371	500	do	16	32	do	do	do	Middle
6377	800	do	20	40	do	do	do	First
6978	800	do	20	40	do	do	do	Last
Logan County:								
6273		do	22	33	Uncovered galvanized iron.	do	Settle and strain.	Middle
6265		do	22	40		Kettles	do	do
6285		do	20	40	Uncovered metal.	Patent	do	do

[a] Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

OHIO—Continued.

(Season February 20 to April 10.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
13	Clear	Burnt	32.68	58.12	8.11	0.68	0.41	+54.00	−23.10	0	None	6309
14	...do	Strong	31.08	57.10	7.37	.73	3.72	+54.70	−21.00	0	...do	6391
9	...do	Fair	32.85	63.32	.80	.79	2.24	+62.60	−21.40	0	...do	6392
8	...do	Good	27.08	67.94	1.15	.64	3.19	+67.21	−22.92	0	...do	6310
14	Cloudy	Burnt	33.20	61.96	1.39	.76	2.69	+60.80	−21.40	0	...do	6393
6+	Clear	Fair	33.08	65.26	.67	.60	.39	+63.25	−23.32	0	...do	6308
13	...do	Strong	29.73	63.60	4.20	.76	1.71	+61.20	−23.20	−0.6	...do	6400
9	...do	Sour	46.71	47.20	3.41	.86	1.82	+45.40	−17.40	0	...do	6401
5	...do	Mild	33.74	63.27	1.11	.59	1.29	+60.40	−23.54	0	...do	6366
5	...do	...do	32.46	65.01	.62	.64	1.27	+63.80	−22.44	0	...do	6985
8	...do	...do	33.96	63.40	.25	.60	1.79	+62.80	−21.40	−1.8	...do	6364
6	...do	Good	31.58	66.43	.52	.64	.83	+64.70	−23.43	0	...do	6365
6	...do	...do	33.11	65.26	.63	.67	.33	+63.80	−22.77	0	...do	6986
6	...do	Strong	32.44	65.64	.97	.55	.40	+63.10	−23.98	0	...do	6363
9	...do	Fair	31.76	56.61	8.27	.67	2.69	+52.55	−22.55	0	...do	6975
8	Cloudy	Good	36.85	61.40	.63	.60	.52	+60.00	−21.45	0	...do	6369
9+	Muddy	Fair	40.48	55.65	3.59	.75	.....	+52.60	−21.23	0	...do	7018
8	Cloudy	Good	32.35	63.55	1.23	.57	2.30	+62.90	−21.40	0	...do	6379
8+	Clear	Fair	33.06	62.75	1.94	.62	1.63	+60.80	−22.00	0	...do	6987
6+	...do	Mild	34.16	62.41	1.25	.61	1.57	+61.35	−21.45	0	...do	6970
7	Cloudy	Fermented	35.26	60.22	2.11	.67	1.74	+59.10	−20.79	0	...do	6977
8	...do	Good	33.90	62.57	.53	.57	2.43	+62.40	−20.60	0	...do	6375
9	Bright	Fair	34.48	61.43	2.65	.63	.81	+59.05	−22.44	0	...do	6380
8	Clear	...do	38.23	60.95	.85	.75	.....	+58.85	−22.00	0	...do	6981
7	Cloudy	Good	34.78	63.35	.53	.65	.69	+62.20	−21.48	0	...do	6367
6	...do	Mild	32.46	64.76	.72	.68	1.38	+63.70	−22.22	0	...do	6991
8	...do	Fair	31.87	66.49	.81	.60	.23	+65.00	−23.21	0	...do	6372
8+	Clear	Good	38.73	57.93	3.08	.76	.....	+55.40	−21.45	0	...do	6982
8	...do	...do	31.87	66.43	.68	.56	.46	+64.80	−23.32	0	...do	6381
7	Cloudy	...do	33.77	64.57	.52	.60	.54	+63.00	−22.66	0	...do	6376
9	Bright	Burnt	37.14	58.83	2.66	.57	.80	+56.70	−21.34	0	...do	6368
8+	Clear	Mild	36.40	61.32	1.10	.51	.67	+59.90	−21.45	0	...do	6371
9	...do	Good	35.27	62.43	.67	.68	.95	+60.60	−22.22	0	Slight	6377
9	...do	...do	34.26	57.21	5.47	.67	2.39	+53.90	−22.00	0	None	6978
7	...do	...do	31.53	65.20	.82	.74	1.71	+64.10	−22.40	0	...do	6273
10	...do	...do	31.71	65.15	.60	.84	1.70	+62.90	−23.20	0	...do	6265
7	Cloudy	...do	30.34	67.08	1.20	.66	.72	+64.35	−24.64	0	...do	6285

Tabulated results of maple sirup investigation, including camp and

OHIO—Continued.

(Season February 20 to April 10.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Logan County □—Con.								
6305	.....	Hard	20	50	Uncovered wood.	Patent	Settle and strain.	First
6306	.....	do	20	50	do	do	do	Middle
6293	.....	do	.....	37	Uncovered metal.	do	do	do
6271	.....	do	.....	40	Uncovered wood.	Kettles	do	do
6290	.....	do	.....	45	Uncovered wood and metal.	do	do	do
6281	.....	do	.....	30–60	Uncovered wood.	Patent	do	First
6298	.....	do	15	40	do	Kettles	do	Middle
6275	.....	do	.....	31	Uncovered metal.	do	do	do
6297	.....	do	25	50	do	Patent	do	do
6292	500	do	20	.....	.....	do	do	do
6296	.....	do	20	40	Uncovered tin.	Kettles	do	do
6291	.....	do	20	60	do	do	do	do
6302	.....	do	.....	45	Uncovered metal.	Patent	do	do
6300	.....	do	25	50	do	do	do	First
6301	.....	do	25	50	do	do	do	Middle
6294	.....	do	25	50	Uncovered metal and wood.	do	do	First
6295	.....	do	25	50	do	do	do	Middle
6307	.....	do	25	30–50	Uncovered wood.	Kettles	do	do
6299	.....	do	20	75	Uncovered tin.	Patent	Eggs and milk.	do
6286	.....	do	.....	32–45	do	do	Strain	do
6262	.....	do	.....	50	Uncovered tin and wood.	Kettles	Strain and settle.	First
6263	.....	do	.....	50	do	do	do	Middle
6274	.....	do	.....	40	do	do	do	do
6304	.....	do	.....	60	Uncovered tin.	do	do	First
6284	.....	do	.....	40	do	do	do	Middle
6267	.....	do	.....	45	do	Patent	do	do
6288	.....	do	.....	60	Uncovered wood and tin.	Kettles	do	do
6264	.....	do	20	40–45	do	do	do	do
6282	.....	do	.....	32–50	do	Patent	do	First
6283	.....	do	.....	32–50	do	do	do	Middle
6280	.....	do	.....	33	Uncovered tin.	Kettles	do	do
6277	.....	Black	.....	40	Uncovered tin and wood.	do	do	do
6303	.....	do	.....	33–40	do	do	do	do
6268	.....	Hard	20	35–40	Uncovered tin.	Patent	do	do
6276	.....	do	.....	40–45	do	do	do	do
6269	.....	do	.....	40–45	do	do	do	do
6278	.....	do	.....	40	Uncovered wood and tin.	Kettles	do	do
6287	.....	do	20	45	do	do	do	do
6266	.....	do	.....	50	do	do	do	do
6279	.....	do	20	45	Uncovered tin.	Steam copper.	do	do
6289	.....	do	25	45	do	do	do	do
6270	.....	do	.....	35	Uncovered wood.	Patent	do	do

manufacturing data, physical properties, and chemical analyses—Continued.

OHIO—Continued.

(Season February 20 to April 10.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
9	Cloudy..	Fair.....	33.11	61.40	0.91	0.72	3.86	+60.30	−21.20	0	None..	6305
10	..do....	.....do.....	32.91	60.90	.91	.77	4.51	+60.80	−20.00	−0.6	...do..	6306
7	..do....	.....do.....	36.16	58.95	.81	.78	3.30	+58.20	−20.00	0	...do..	6293
8	Clear....	Good.....	32.28	64.37	1.02	.79	1.54	+63.40	−22.00	0	...do..	6271
10	Cloudy..	Peculiar...	35.81	60.23	1.76	.71	1.49	+60.10	−19.80	0	...do..	6290
8	..do....	Good.....	31.69	66.54	.97	.63	.17	+63.90	−24.37	0	...do..	6281
10	Clear....	Burnt.....	35.98	55.33	5.22	.98	2.49	+52.40	−21.00	0	...do..	6298
7	Cloudy..	Fair.....	33.73	62.26	1.36	.88	1.77	+61.20	−21.40	0	...do..	6275
7	..do....	Good.....	33.40	61.50	.84	.71	3.55	+61.60	−21.00	0	...do..	6297
11	Clear....	Strong.....	43.26	52.46	1.41	.77	2.10	+51.60	−18.00	0	...do..	6292
7	Cloudy..	Fair.....	32.06	64.60	.74	.68	1.92	+63.70	−22.00	0	...do..	6296
9	Clear....	Burnt.....	33.31	61.74	1.93	.67	2.35	+61.30	−20.60	0	...do..	6291
9	Cloudy..	Good.....	32.53	62.41	.24	.78	4.04	+62.00	−20.80	0	...do..	6302
9	Clear....	Fair.....	36.98	59.32	.92	.86	1.92	+58.90	−19.80	0	...do..	6300
9	...do....	.....do.....	38.63	55.63	1.35	.89	3.50	+56.80	−17.00	0	...do..	6301
8	..do....	Good.....	32.23	64.90	.79	.69	1.39	+64.30	−21.80	0	...do..	6294
8	Cloudy..	.....do.....	30.44	67.33	.73	.72	.78	+64.90	−24.42	0	...do..	6295
12	Clear....	Fair.....	31.56	62.96	.81	.79	3.88	+61.30	−22.22	0	...do..	6307
9	Cloudy..	Good.....	34.73	60.91	1.08	.83	2.45	+60.20	−20.60	0	...do..	6299
10	...do....	.....do.....	32.41	63.48	1.76	.67	1.68	+61.40	−22.40	0	...do..	6286
9	...do....	Fair.....	33.96	63.11	1.35	.75	.83	+60.95	−22.77	0	...do..	6262
8	...do....	.....do.....	33.73	63.84	1.01	.74	.68	+61.70	−22.99	0	...do..	6263
8	Clear....	.....do.....	32.88	62.71	1.32	.68	2.41	+61.80	−21.40	0	...do..	6274
13	...do....	.....do.....	34.55	60.38	1.04	.77	3.26	+59.20	−20.90	+1.0	...do..	6304
8	Cloudy..	Old.....	35.72	61.21	.81	.77	1.49	+59.80	−21.40	0	...do..	6284
8	Clear....	Poor.....	35.47	62.04	1.27	.68	.54	+60.90	−21.40	0	...do..	6267
10	...do....	Fair.....	34.01	62.26	1.00	.75	1.98	+61.60	−21.00	0	...do..	6288
7	...do....	Good.....	34.23	63.74	.73	.73	.57	+61.90	−22.66	0	...do..	6264
6	Cloudy..	Fair.....	31.09	66.90	.85	.72	.44	+64.55	−24.20	0	...do..	6282
6	...do....	.....do.....	30.89	66.64	1.06	.72	.69	+64.10	−24.31	0	...do..	6283
7	...do....	.....do.....	32.71	64.98	.31	.80	1.20	+63.60	−22.60	0	...do..	6280
10	Clear....	Old.....	33.16	63.32	1.01	.75	1.76	+62.00	−22.00	0	...do..	6277
12	...do....	Burnt.....	32.03	62.00	.95	.83	4.19	+60.30	−22.00	−1.0	...do..	6303
12	...do....	Good.....	24.85	70.42	1.32	.68	2.73	+68.96	−24.46	0	...do..	6268
9	...do....	Fair.....	34.96	60.00	2.72	.85	1.47	+58.00	−21.60	0	...do..	6276
11	...do....	Rank.....	36.32	58.42	3.33	.76	1.17	+56.60	−21.00	0	...do..	6269
10	...do....	Fermented.	38.17	58.50	2.21	.88	.24	+57.00	−20.60	0	...do..	6278
8	...do....	Good.....	31.84	67.30	.55	.71	.....	+65.30	−23.98	0	...do..	6287
9	Cloudy..	Poor.....	33.31	62.34	1.51	.92	1.92	+61.30	−21.40	0	...do..	6266
7	...do....	Good.....	33.71	64.09	.52	.66	1.02	+62.70	−22.00	0	...do..	6279
9	Clear....	Burnt.....	39.16	55.25	2.08	.84	2.67	+55.60	−17.80	0	...do..	6289
9	Cloudy..	Old.....	37.02	59.02	1.73	.82	1.41	+57.50	−20.80	0	...do..	6270

Tabulated results of maple sirup investigation, including camp and

OHIO—Continued.

(Season February 20 to April 10.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Logan County ◻—Con.								
6272	.....	Hard	.....	45	Uncovered wood and tin.	Kettles	Strain and settle.	Middle
Mahoning County: ◸								
6650	100	do	13	32–48	Uncovered wood.	Iron pan	do	First
6651	220	do	13	32	Uncovered wood and tin.	do	Milk and soda.	do
6988	220	do	13	32	do	do	do	Last
6652	250	do	.....	.....	Uncovered metal.	do	Strain and settle.	First
6984	250	do	.....	.....	do	do	do	Last
Medina County: ◻								
6974	1,000	do	16	32	Uncovered tin.	Patent	Settle and strain.	Last
6360	1,050	do	16–17	45	Covered iron.	do	do	First [a]
6976	1,050	do	16–17	45	do	do	do	Last [a]
6256	1,600	do	16	32–50	Uncovered tin.	do	Eggs	Middle clarified.
6257	1,600	do	16	32–50	do	do	do	Middle not clarified.
6971	1,600	do	16	32–50	do	do	do	Last
6689	1,200	do	15	40	Covered tin.	do	Settle and strain.	Second
6690	1,200	do	15	40	do	do	do	First
6691	1,200	do	15	40	do	do	do	Last
6254	300	do	13	52	Uncovered tin.	do	Eggs and milk.	First clarified.
6255	300	do	13	52	do	do	do	First not clarified.
6989	300	do	13	52	do	do	do	Last
6252	1,200	do	35	40–52	Uncovered tin.	do	Milk and eggs.	First not clarified.
6253	1,200	do	35	40–52	do	do	do	First clarified.
6980	1,200	do	35	40–52	do	do	do	Last [a]
Morrow County: ◻								
6347	.....	do	.....	40	do	Iron pan	Eggs	Middle
6337	.....	do	20	50	Uncovered wood and metal.	Patent	Settle and strain.	do
6357	.....	do	.....	50	do	Iron pan	Eggs and milk.	do [a]
6355	.....	do	.....	60	do	Patent	Settle.	.....
6332	.....	do	.....	40	Uncovered tin.	Iron pan	Eggs and milk.	Not clarified.
6333	.....	do	.....	40	do	do	do	Clarified
6334	.....	do	.....	45	Uncovered tin and wood.	Kettles	Eggs and settle.	Middle [a]
6352	.....	do	.....	50	Uncovered metal.	Iron pan	Milk and eggs, soda.	Clarified. [a]
6353	.....	do	.....	50	do	do	do	Not clarified.
6354	.....	do	.....	50	do	do	do	Middle

[a] Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

OHIO—Continued.

(Season February 20 to April 10.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
									Invert.			
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	At 20° C.	At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
7	Clear....	Good.....	31.68	64.83	1.29	0.79	1.41	+64.10	−22.00	0	None.	6272
12	Cloudy..	Poor.....	28.68	64.07	5.24	.66	1.35	+66.90	−24.09	0	...do..	6650
11	...do....	Fermented.	33.24	60.74	3.77	.82	1.43	+58.30	−22.28	0	Slight.	6651
15	Clear....	Molasses....	31.96	59.34	6.15	.88	1.67	+56.50	−22.22	0	...do..	6988
13	Cloudy..	Strong.....	35.31	57.82	5.22	.68	.97	+54.70	−22.00	0	None.	6652
13	Clear....	Good.....	30.09	62.85	4.54	.80	1.72	+59.40	−23.98	0	...do..	6984
10	...do....	.....do.....	30.81	63.40	3.57	.72	1.50	+60.90	−23.21	0	...do..	6974
6	Cloudy..	Fair.....	43.73	53.54	1.25	.52	.96	+52.00	−19.03	0	...do..	6360
12	Clear....	Mild.....	42.18	54.56	1.51	.60	1.15	+52.80	−19.58	0	...do..	6976
8	...do.....	Good.....	31.46	67.37	.68	.60	.....	+65.50	−23.87	0	...do..	6256
7	Cloudy..	.....do.....	32.60	67.23	.73	.58	.....	+66.00	−24.20	0	...do..	6257
10	Clear....	.....do.....	33.46	61.52	2.51	.78	1.73	+59.40	−22.22	0	...do..	6971
7	Cloudy..	Mild.....	35.48	62.26	.71	.63	.92	+60.70	−21.89	0	...do..	6689
5	...do.....	Peculiar....	34.74	63.58	.48	.58	.62	+61.90	−22.44	0	...do..	6690
8+	...do.....	Mild.....	35.37	61.90	.95	.78	1.00	+60.00	−22.11	0	...do..	6691
8	Clear....	Fair.....	35.46	62.57	.98	.57	.42	+61.00	−22.00	0	...do..	6254
8	Cloudy..	.....do.....	34.88	62.78	1.23	.64	.47	+61.00	−22.28	0	...do..	6255
9	Clear....	Mild.....	34.56	62.00	2.17	.79	.48	+59.80	−21.45	0	...do..	6989
8	Cloudy..	Good.....	33.46	65.57	1.38	.53	.....	+64.00	−22.99	0	...do..	6252
9	Clear....	.....do.....	32.01	66.05	1.10	.52	.32	+64.30	−23.32	0	...do..	6253
11	...do.....	.....do.....	38.09	58.05	2.00	.73	1.13	+56.00	−21.01	0	...do..	6980
10	...do.....	Mild.....	33.78	62.97	1.33	.78	1.14	+61.10	−22.44	0	...do..	6347
10	...do.....	Burnt.....	33.15	63.62	2.39	.57	.23	+61.30	−23.10	0	...do..	6337
10+	...do.....	Mild.....	33.83	60.51	4.24	.83	.59	+57.50	−22.77	0	...do..	6357
9	...do.....	Poor.....	31.58	66.30	.46	.69	.97	+65.20	−22.80	0	...do..	6355
8	Cloudy..	Mild.....	44.81	53.06	.60	.66	.87	+51.25	−19.14	0	...do..	6332
8	Clear....	Woody.....	31.96	66.11	.66	.83	.44	+64.10	−23.60	0	...do..	6333
7+	...do.....	Mild.....	36.51	59.84	2.72	.58	.35	+57.60	−21.78	0	...do..	6334
8	...do.....	.....do.....	38.23	59.13	1.87	.67	.10	+57.10	−21.34	0	...do..	6352
8	Cloudy..	Fair.....	34.25	62.00	.19	.76	2.80	+61.70	−20.60	−1.0	...do..	6353
6	...do.....	Poor.....	35.43	61.90	.19	.77	1.71	+61.00	−21.20	0	...do..	6354

Tabulated results of maple sirup investigation, including camp and

OHIO—Continued.

(Season February 20 to April 10.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Morrow County □—Con.								
6331		Hard		50	Uncovered metal.	Patent	Strain	Middle
6344		do		45	Covered wood.	do	do	do
6349		do		45	Uncovered tin.	do	do	do
6339		do		40	do	Iron pans.	Eggs and milk.	Not clarified.[a]
6335		do		50	Uncovered wood.	Iron pan	do	Clarified
6330		do		35	Covered tin.	Patent	Strain	Not clarified.[a]
6350		do		45	Uncovered wood and metal.	Iron pan	Strain and settle.	do
6351		do	20	40	Covered tin.	Patent	do	
6343		do	20	45	do	do	do	Middle
6340		do		40	Uncovered tin and wood.	do	do	do
6341		do		40	Uncovered metal.	do	do	do
6336		do		50	Uncovered wood.	Iron pan	Eggs and milk.	
6348		do		40	do	do		Middle[a]
6338		do		50	Covered metal.	Patent	Sweet milk	
6356		do		45	Uncovered wood.	do	Strain and settle.	(a)
6342		do			Covered metal.	do	do	Middle
6345		do		50	Uncovered wood and tin.	do	do	do
Portage County: ♂								
6361	1,400	do	15	36–48	Uncovered iron.	do	do	First
6983	1,400	do	15	36–48	do	do	do	Last[a]
6362	600	do	16	40	Covered tin.	do	do	First
Trumbull County: ♂								
6648	500	do	16–32	32–48	Painted tin	do	do	do
6649	500	do	8–15	44	Uncovered wood.	do	Eggs and milk.	do
6979	500	do	8–15	44	do	do	do	Last
Union County: □								
6311		do		45	Uncovered wood and tin.	Kettle	Strain and settle.	Middle
Average (141)								
Maximum								
Minimum								

[a] Sample crystalized and was reboiled.

manufacturing data, physical properties, and chemical analyses—Continued.

OHIO—Continued.

(Season February 20 to April 10.)

Physical properties.			Chemical analysis.					Polarizations.				
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.	Tannin reaction.	Serial number.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
6	Cloudy..	Fair.....	32.06	66.40	0.55	0.70	0.29	+64.10	−23.98	0	None..	6331
8	...do....	.....do.....	33.02	64.77	.99	.72	.50	+62.60	−23.32	0	...do..	6344
7	...do....	Good.....	32.33	65.62	.54	.71	.80	+64.00	−23.05	0	...do..	6349
6+	Clear....	.....do.....	34.11	62.88	1.93	.68	.40	+60.00	−23.43	0	...do..	6339
7	...do....	Mild.....	33.61	63.98	.71	.81	.89	+62.00	−22.88	0	...do..	6335
7+	...do....	.....do.....	31.86	66.49	.70	.68	.27	+64.60	−23.60	0	...do..	6330
7	...do....	Fair.....	34.21	60.02	3.90	.74	1.13	+56.20	−23.43	0	...do..	6350
6	Cloudy..	.....do.....	30.86	67.25	.49	.61	.79	+65.45	−23.76	0	...do..	6351
8	Clear....	.....do.....	32.01	65.36	1.14	.69	.80	+63.05	−23.65	0	...do..	6343
8	Cloudy..	.....do.....	32.41	65.42	.59	.79	.79	+63.30	−23.49	0	...do..	6340
7	...do....	Good.....	32.26	65.84	.64	.74	.52	+63.80	−23.54	0	...do..	6341
6	...do....	Mild.....	36.15	61.82	.49	.89	.65	+59.90	−22.11	0	...do..	6336
10+	Clear....	.....do.....	39.51	58.50	1.54	.66	.....	+56.50	−21.12	0	...do..	6348
7	Cloudy..	Woody.....	34.21	64.26	.60	.68	.25	+62.70	−22.55	0	...do..	6338
10	Clear....	Good.....	34.00	61.62	3.25	.60	.53	+58.10	−23.65	0	...do...	6356
9	Cloudy..	Mild.....	36.11	60.30	1.88	.81	.80	+58.10	−21.89	0	...do...	6342
9	...do....	.....do.....	31.93	63.85	3.09	.66	.47	+61.50	−23.21	0	...do...	6345
8	...do....	Poor.....	31.24	66.10	.40	.65	1.61	+66.00	−21.80	−0.8	...do...	6361
6	Clear....	Mild.....	37.84	59.64	1.36	.48	.68	+58.00	−21.12	0	...do...	6983
9	Cloudy..	Fermented .	34.76	62.20	.69	.66	1.69	+61.60	−21.00	+0.6	...do...	6362
6+	...do....	Fair.....	32.43	65.81	.90	.61	.25	+63.70	−23.60	0	...do...	6648
7	...do....	Poor.....	37.28	60.30	1.46	.69	.27	+58.00	−22.00	0	Slight.	6649
7	Clear....	Good.....	37.13	60.62	2.02	.72	.....	+58.20	−22.22	0	None..	6979
8	Cloudy..	Sour.....	30.09	67.40	1.75	.69	.07	+65.10	−24.31	0	...do...	6311
8	.....	.....	34.02	62.43	1.63	.70	1.22	+60.68	−22.08	.....	.....	
15	.....	.....	46.71	70.42	8.27	.98	4.51	+68.96	−24.64	.....	.....	
5	.....	.....	24.85	47.20	.19	.48	.00	+45.40	−17.00	.....	.....	

Tabulated results of maple sirup investigation, including camp and

PENNSYLVANIA.

(Season March 1 to April 15.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Bradford County:								
6846	600	Hard	12	32	Covered tin.	Patent	Milk and settle.	Early [a]
6857	1,000	do		32–50	Uncovered tin.	do	Strain and settle.	do. [a]
6845	400	do			do	do	do	Middle
6856	[*]600	Hard and soft.			Covered tin.	do	do	do
6854	85	Hard	20	30–50	Uncovered tin.	Iron pan	do	First [a]
6855	85	do	20	30–50	do	do	do	1908 [a]
6853	300	do	10	32	do	Patent	do	Middle [a]
Fayette County:								
6852	1,000	do		32	do	do	do	Early
6848	1,500	do	15		do	do	do	do. [a]
6849		do			Covered tin.	do	do	do. [a]
6847	600	do	18	32	Uncovered tin.	do	do	First
6851	600	do	18		do	do	do	Fifth
6850		do				do	do	Early [a]
Lancaster County:								
6836	1,400	do	[b] 5	64	Uncovered wood.	Iron pans.	Settle and skim.	Early [a]
Somerset County:								
6863		do						Third [a]
6859	300	do	[b] 8	34	Uncovered wood and metal.	Kettles and pan.	Skim and settle.	Middle [a]
6838		do						do. [a]
6842		do	20–25	35	Uncovered wood and tin.	Iron pan		Early [a]
6843		do	8–16	32	Uncovered metal.	Patent		Middle
6860		do	32	32	Uncovered wood and tin.	Iron pan		Early [a]
6861		Hard and soft.	20		do	Patent		(a)
6885								
6839		Hard	32	40–50	Uncovered wood.	Iron pan		Middle [a]
6862	1,800	do		35	do	do	Skim and settle.	Fifth
6844								Middle
6841	300	Hard	[b] 3–4	35–40	Uncovered wood.	Iron pans.	Skim and settle.	Fourth [a]
6840		do	25–30		Covered wood.	do		First [a]
6837								Middle
Warren County:								
6402	475	Hard	15	50	Covered tin.	Patent	Strain and settle.	
6423		Rock	17	50	do	Iron pans	Strain	First
6407		Hard		60	do	Patent	do	do
6411	140	do	20	45	do	do	do	Second
6417								1908
6418								First
6409	250	Hard	9–15	32	Covered tin.	Patent	Milk	First
6427	250	do	12	32	do	Iron pan	Strain and settle.	do. [a]
6419		do	35–50	50	Uncovered metal.	Patent	do	do. [a]

[a] Sample crystallized and was reboiled.
[b] Pounds of sugar.

manufacturing data, physical properties, and chemical analysis—Continued.

PENNSYLVANIA.

(Season March 1 to April 15.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
7	Cloudy..	Mild.....	36.99	59.02	3.23	0.52	0.24	+56.40	−21.89	0	None..	6846
6	Clear....	.....do.....	37.65	60.24	1.07	.58	.46	+57.70	−22.22	0	...do...	6857
8	...do.....	Peculiar....	34.92	61.19	1.97	.60	1.32	+59.50	−21.67	0	...do...	6845
8	...do.....	Fair.....	33.82	64.11	.58	.68	.81	+62.50	−22.55	0	...do...	6856
6+	...do.....	Mild.....	37.61	59.94	.79	.69	.97	+58.50	−21.01	0	...do...	6854
13	...do.....	Strong.....	33.19	54.90	9.37	.78	1.76	+49.40	−23.43	0	...do...	6855
10	...do.....	Mild.....	34.41	62.73	1.48	.69	.69	+60.90	−22.33	0	...do...	6853
8+	...do.....	.....do.....	32.52	65.08	.54	.71	1.15	+64.00	−22.33	0	...do...	6852
5	...do.....	.....do.....	37.18	61.09	.41	.64	.68	+59.70	−21.34	0	...do...	6848
6+	...do.....	.....do.....	37.73	60.08	.93	.71	.55	+58.25	−21.45	0	...do...	6849
6+	...do.....	Fair.....	32.52	65.08	.50	.66	1.24	+64.00	−22.33	0	...do..	6847
6+	...do.....	Mild.....	31.52	65.79	.51	.64	1.54	+64.50	−22.77	0	...do...	6851
7+	...do.....	Good.....	37.41	58.67	2.79	.78	.35	+56.60	−21.23	0	...do...	6850
9	...do.....	.....do.....	36.51	58.93	3.15	.70	.71	+56.50	−21.67	0	...do...	6836
5+	...do.....	Mild.....	37.81	59.48	1.23	.67	.81	+57.90	−21.01	0	...do...	6863
8	Cloudy..	Good.....	36.31	60.30	1.96	.73	.70	+58.55	−21.45	0	...do...	6859
8+	Clear....	Mild.....	37.00	59.59	2.49	.73	.19	+57.60	−21.45	0	...do...	6838
8+	...do.....	.....do.....	36.96	59.84	2.22	.86	.12	+57.60	−21.78	0	...do...	6842
12	...do.....	Burnt.....	33.82	60.67	3.83	.72	.96	+58.70	−21.78	0	...do...	6843
7	...do.....	Good.....	34.86	60.22	3.56	.74	.62	+58.00	−21.89	0	...do...	6860
6+	...do.....	.....do.....	36.46	60.19	1.43	.85	1.07	+58.50	−21.45	0	...do...	6861
12	...do.....	Strong.....	31.11	65.29	2.18	.73	.69	+63.30	−23.32	0	...do...	6885
7	...do.....	Mild.....	35.81	61.51	1.95	.63	.10	+59.50	−22.11	0	...do...	6839
9	...do.....	Poor.....	32.77	63.97	1.83	.77	.66	+62.10	−22.77	0	...do...	6862
8	...do.....	Peculiar....	32.72	65.21	1.68	.67	.....	+62.50	−22.00	0	...do...	6844
7+	Cloudy..	Mild.....	38.76	58.67	2.72	.61	.....	+56.60	−21.23	0	...do...	6841
9+	...do.....	Good.....	35.59	60.84	2.72	.67	.18	+58.60	−22.11	0	...do...	6840
9	Clear....	Mild.....	31.72	64.84	1.02	.78	1.64	+63.90	−22.11	0	...do...	6837
7	Cloudy..	Fair.....	32.78	65.90	.36	.54	.42	+65.00	−22.40	0	...do...	6402
8	Clear....	Rank.....	33.01	64.79	1.06	.56	.58	+64.20	−22.40	0	...do...	6423
8	...do.....	Fair.....	34.05	61.89	.76	.59	2.71	+61.70	−20.40	0	...do...	6407
7	...do.....	.....do.....	32.86	65.39	.77	.64	.34	+65.00	−22.40	0	...do...	6411
8	...do.....	Good.....	32.35	64.37	.86	.59	1.83	+63.40	−22.00	0	...do...	6417
6	Cloudy..	Poor.....	30.96	66.74	1.12	.66	.52	+66.20	−23.00	0	...do...	6418
7	Clear....	Fair.....	30.48	64.30	2.63	.59	2.00	+62.30	−23.00	0	...do...	6409
6	Cloudy..	Good.....	30.01	68.82	.93	.75	.....	+67.10	−24.20	0	...do...	6427
8	...do.....	.....do.....	29.46	68.57	.82	.66	.49	+67.10	−23.87	0	...do...	6419

Tabulated results of maple sirup investigation, including camp and

PENNSYLVANIA—Continued.

(Season March 1 to April 15.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Warren County □—Con.								
6410	160	Hand	30	45	Covered tin.	Patent	Strain and settle.	First
6422		White	12	40	do	do	do	do
6416	300	Hard	20	40	do	do	do	do
6408	700		10	30	do	do	do	do
6414	150	White	13	32	do	Iron pan	do	1908
6412		Hard		45	do	do	Milk and eggs.	First
6424	275	Rock	30	45	do	do	Strain and settle.	do
6426			8–10	40–50	do	Patent	do	do
6403								
6425	500	Hard	12	32	Covered tin.	Patent	Strain and settle.	1908
6428	500	do	12	32	do	do	do	First [a]
6405	270	do	16	32	do	do	do	
6413	400	do	11	32	do	do	do	First [a]
6406	200	do	20	32–50	do	Iron pan	do	do
6420	340	do	15	32–50	do	Patent	do	do
6421	340	do	15	32–50	do	do	do	1908
6429	340	do	15	32–50	do	do	do	[b]1908
6858		do			do	do	do	(a)
Average (55)								
Maximum								
Minimum								

VERMONT.

(Season March 15 to May 1.)

Addison County: □								
6706	800	Hard	[b] 3	30	Uncovered tin.	Patent	Strain and settle.	Middle [a]
6705								do
Bennington County: □								
6609						Kettles		do
Chittenden County: □								
6707	500	Hard	4	20–25	Covered wood.	Patent	Strain and settle.	Early
6708	500	do	4	20–25	do	do	do	do
6709								do
Franklin County: □								
6725								1908
6726								Last
6722	1,000	Hard	1½–3½	30	Uncovered tin.	Patent	Skim and settle.	Last
6721								do. [a]
6723	500	Hard	3	35	Uncovered tin.	Patent	Strain and settle.	
6724								
6720	475	Hard	2		Uncovered tin and wood.	Patent	Milk	Second
Lamoille County: □								
6738	2,000	do	3	32	Uncovered tin and wood.	do	Skim and settle.	
6736								
6739	1,200	Hard	2½	32	Uncovered tin.	Patent	Skim and settle.	
6733								
6732								
6741	620	Hard	3–5	20–24	Uncovered wood and tin.	Patent	Milk	

[a] Sample crystallized and was reboiled. [b] Buddy.

[c] All Vermont data reported as pounds of sugar per tree.

manufacturing data, physical properties, and chemical analysis—Continued.

PENNSYLVANIA—Continued.

(Season March 1 to April 15.)

Physical properties.			Chemical analysis.					Polarizations.				
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.	Tannin reaction.	Serial number.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
8	Cloudy..	Good.....	33.96	63.74	1.23	0.64	0.43	+63.20	−22.00	0	None..	6410
8	Clear....	Rank.....	32.86	65.16	.78	.60	.60	+64.70	−22.40	0	...do...	6422
9	Cloudy..	Good.....	34.51	62.70	1.02	.70	1.07	+62.60	−21.20	0	...do...	6416
7	Clear....	.....do.....	33.75	62.57	.50	.62	2.56	+62.60	−20.40	0	...do...	6408
8	Cloudy..	Poor.....	37.37	58.73	2.04	.78	1.08	+57.50	−21.00	0	...do...	6414
8	Clear....	Good.....	33.60	63.24	.35	.61	2.20	+63.10	−20.80	0	...do...	6412
8	Cloudy..	Poor.....	30.96	67.71	.58	.72	.03	+67.10	−23.40	0	...do...	6424
12	...do....	Strong.....	30.11	66.30	1.81	.63	1.15	+65.00	−23.00	−2.0	...do...	6426
7	Clear....	Good.....	33.25	63.62	.71	.63	1.79	+63.40	−21.00	0	...do...	6403
8	...do....	Mild.....	33.36	61.60	2.91	.61	1.52	+59.20	−22.60	−0.6	...do..	6425
9	...do....	Good.....	35.33	63.15	.65	.60	.27	+62.00	−21.78	0	...do..	6428
8	.....	.....	31.50	65.66	.67	.63	1.54	+65.30	−21.80	0	...do..	6405
8	Cloudy..	Fair.....	35.62	61.80	.92	.77	.89	+61.40	−21.20	0	...do..	6413
9	Clear....	Good.....	32.28	64.50	.50	.66	2.06	+64.30	−21.40	0	...do..	6406
7	Cloudy..	Woody.....	33.56	63.97	.92	.60	.95	+63.30	−22.20	0	...do..	6420
13	Clear....	Burnt.....	34.46	61.57	2.17	.66	1.14	+60.70	−21.60	0	...do..	6421
10	...do....	Strong.....	32.85	63.40	1.55	.63	1.57	+61.60	−22.60	−2.4	...do..	6429
7	...do....	Mild.....	36.45	59.78	2.30	.51	.96	+57.10	−22.22	0	...do..	6858
8	.....	.....	34.13	62.68	1.62	.67	.90	+61.23	−22.02	.....	.....	
13	.....	.....	37.81	68.82	9.37	.86	2.71	+67.10	−24.20	.....	.....	
5	.....	.....	29.46	54.90	.36	.51	.00	+49.40	−20.40	.....	.....	

VERMONT.

(Season March 15 to May 1.)

9+	Cloudy..	Mild.....	39.00	58.91	0.25	0.50	1.34	+56.70	−21.45	0	None..	6706
9	...do....	.....do.....	30.87	68.01	.29	.61	.22	+66.00	−24.20	0	...do..	6705
12	...do....	.....do.....	31.60	66.18	.83	.69	.70	+65.00	−22.80	.....	...do..	6609
7+	Clear....	Buddy.....	34.67	63.41	.28	.52	1.12	+60.80	−23.32	0	...do..	6707
10	...do....	Good.....	35.22	60.66	1.45	.71	1.96	+57.70	−22.77	0	...do..	6708
8+	...do....	Mild.....	38.52	59.65	.33	.60	.90	+57.80	−21.33	0	...do..	6709
7	...do....	.....do.....	31.58	55.86	9.03	.55	2.98	+49.90	−24.20	0	...do..	6725
12	...do....	.....do.....	33.43	63.10	1.59	.87	1.01	+60.60	−23.10	0	...do..	6726
6	...do....	.....do.....	34.43	63.56	.21	.59	1.21	+61.10	−23.21	0	...do..	6722
11+	...do....	.....do.....	35.76	59.83	2.67	.49	1.25	+56.60	−22.77	0	...do..	6721
7+	Cloudy..	.....do.....	31.83	66.38	.29	.59	.91	+64.40	−23.65	0	...do..	6723
7+	...do....	Buddy.....	32.33	65.33	.41	.62	1.31	+62.90	−23.76	0	...do..	6724
9	Clear....	Mild.....	31.98	64.96	.72	.57	1.77	+62.30	−23.87	0	...do..	6720
11	...do....	Fair.....	36.13	58.55	3.48	.56	1.28	+56.00	−21.67	0	...do...	6738
11	...do....	.....do.....	32.55	66.06	.84	.53	.02	+63.10	−24.53	0	...do...	6736
9+	...do....	.....do.....	31.70	67.02	.46	.72	.10	+64.60	−24.31	0	...do...	6739
10	Cloudy..	.....do.....	37.55	60.63	.45	.72	.65	+58.20	−22.22	0	...do...	6733
11+	...do....	Strong.....	39.00	59.30	.52	.61	.57	+57.00	−21.67	0	...do...	6732
7+	Clear....	Flat.....	31.95	66.15	.20	.58	1.12	+64.10	−23.65	0	...do...	6741

Tabulated results of maple sirup investigation, including camp and

VERMONT—Continued.

(Season March 15 to May 1.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Lamoille Co. ⊡—Cont'd.								
6728								
6768								
6769	600	Hard	2½–4	32–40	Covered wood and tin.	Iron pan	Skim and settle.	(a)
6734								
6771	675	Hard	3	35	Uncovered tin.	Pans	Skim and settle.	
6730	1,300	do	2½–4¾	32	Covered tin and wood.	Patent	do	
6740	950	do	3	30	Uncovered tin.	do	do	
6770								
6731	550	Hard	3–3½	30–32	Painted wood.	Patent	Skim and settle.	
6727	500	do	4	40	Covered tin.	do	do	
6737	800	do	3	35–40	Uncovered wood and tin.	do	Cream	
6729								
6735	1,000	Hard	2–3	32–35	Uncovered painted wood.	Patent	Skim and milk.	
6742	150	do	2½					
Orleans County: ⊡								
6780	950	do	3	30–32	Uncovered tin and wood.	Patent	Skim and settle.	
6772	1,200	do	3					
6777	800	do	3½	10–12	Covered tin.	Patent	Skim and settle.	
6778	1,000	do	2½	8	Uncovered wood.	do	do	
6782	5,000	do	3–4	24–30	Uncovered galvanized iron.	do	Eggs and milk.	
6776	1,300	do	3½	32	Uncovered tin and wood.	do	Skim and settle.	
6781	550	do	2½		Uncovered wood and tin.	Iron pans.	do	
6773	1,100	do	2	32	do	Patent	do	
6774	300	do	2					
6775	300	do	2½		Uncovered wood and tin.	Iron pans.	Use sap	(a)
6779	1,000	do	2½	32	do	Patent	Skim and settle.	
Rutland County: □								
6635	400	Soft	3	25–30	Uncovered tin.	do	Eggs and milk.	Middle
6634	1,200	Hard	3	32	do	do	Settle and skim.	Middle
6633	1,200	do	3	32	do	do	do	First
Windham County: ⊟								
6612	800	Hard	2½–3	50–60	Uncovered wood.	do	do	Middle
6610								First
6611								Middle
Average (50)								
Maximum								
Minimum								

a Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analysis—Continued.

VERMONT—Continued.

(Season March 15 to May 1.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
9	Clear	Fair	34.00	63.82	0.78	0.54	0.86	+60.90	−23.87	0	None	6728
7	Cloudy	Flat	31.35	66.90	.20	.54	1.01	+65.10	−23.65	0	...do...	6768
13	Clear	Strong	32.00	63.24	2.04	.66	2.06	+59.70	−24.20	0	...do...	6769
11+	Cloudy	...do...	33.38	65.20	.64	.64	.14	+62.50	−23.98	0	...do...	6734
7+	Clear	Fair	37.80	60.58	.20	.53	.89	+58.80	−21.56	0	...do...	6771
7	...do...	...do...	35.31	63.92	.30	.52	.....	+61.70	−23.10	0	...do...	6730
6+	Cloudy	Good	35.15	62.79	.20	.51	1.35	+60.30	−22.99	0	...do...	6740
12	Clear	Flat	37.55	60.03	.80	.60	1.02	+58.40	−21.23	0	...do...	6770
6	Cloudy	Fair	36.00	62.87	.54	.55	.04	+60.40	−22.99	0	...do...	6731
11+	Clear	...do...	40.09	59.33	.37	.64	.....	+55.60	−23.10	0	...do...	6727
9+	...do...	...do...	33.25	63.81	.99	.55	1.40	+62.10	−22.55	0	...do...	6737
7+	Cloudy	Good	31.88	66.72	.33	.54	.53	+64.30	−24.20	0	...do...	6729
10	Clear	Rank	32.98	63.31	1.74	.67	1.30	+60.00	−23.98	0	...do...	6735
7+	...do...	Fair	33.30	64.74	.33	.61	1.02	+63.00	−22.88	0	...do...	6742
10	...do...	Good	35.33	62.59	1.31	.55	.22	+60.70	−22.33	0	...do...	6780
9	Cloudy	Fair	31.75	65.72	1.04	.62	.87	+63.20	−23.98	0	...do...	6772
8	Clear	Good	34.64	64.12	.36	.56	.32	+62.40	−22.66	0	...do...	6777
14+	Cloudy	Burnt	29.78	55.64	10.23	.92	3.43	+51.80	−22.00	.....	Slight.	6778
9	Clear	Good	30.98	67.40	.66	.58	.38	+65.20	−24.20	0	None	6782
11+	...do...	Poor	37.94	60.46	1.64	.65	.....	+58.20	−22.00	0	...do...	6776
10	Cloudy	Fair	36.23	58.83	2.76	.53	1.65	+57.80	−20.24	0	...do...	6781
10	Clear	Good	29.85	67.24	1.61	.54	.76	+65.00	−24.20	0	...do...	6773
11	...do...	Fair	33.54	62.53	2.31	.58	1.04	+60.40	−22.55	0	Slight.	6774
10	...do...	...do...	35.34	60.82	2.09	.62	1.13	+58.30	−22.38	0	None.	6775
9	...do...	Mild	40.53	57.40	.64	.55	.88	+55.90	−20.24	0	...do...	6779
11+	...do...	Fair	37.70	59.80	.26	.57	1.67	+58.10	−21.20	0	...do...	6635
6	...do...	Woody	41.50	55.90	.17	.54	1.89	+54.70	−19.40	0	...do...	6634
8	...do...	...do...	35.60	61.90	.60	.59	1.31	+66.60	−21.50	0	...do...	6633
6	Cloudy	Mild	48.14	49.52	.53	.70	1.11	+48.50	−17.20	0	...do...	6612
6	...do...	Good	32.66	64.97	.67	.63	1.07	+64.00	−22.20	0	...do...	6610
8	...do...	...do...	41.10	56.38	.78	.63	1.11	+55.41	−19.38	0	...do...	6611
9	.....	.....	34.93	62.24	1.23	.60	1.00	+59.96	−22.61	.....	.....	
14+	.....	.....	48.14	68.01	10.23	.92	3.43	+66.00	−24.53	.....	.....	
6	.....	.....	29.78	49.52	.17	.49	.00	+48.50	−17.20	.....	.....	

Tabulated results of maple sirup investigation, including camp and

WEST VIRGINIA.

(Season February 1 to March 15.)

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Greenbrier County:								
6653	65	Hard	10	65	Uncovered tin.	Iron pan	Eggs and milk.	Middle
6990	65	do	10	65	do	do	do	Last [a]
Upshire County:								
6654	200	do	30	60–65	Uncovered wood and tin.	Patent	Settle and strain.	
Average (3)								
Maximum								
Minimum								

UNITED STATES.

Average (395)								
Maximum								
Minimum								

CANADA.

Province of Quebec:								
6822								
6917	800	Hard						
6804								
6899		Soft and hard.						
6928								
6925								
6918	700	Hard						
6911								
6831								
6919	575	Soft and hard.						
6930								
6914								
6913								
6904								
6934								
6903								
6933								
6886								
6909								
6820								
6907								
6908								
6902								
6827								
6818								
6890								
6900								
6828								
6910								
6887								
6892								
6893								
6816								
6901								
6895								

[a] Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analysis—Continued.

WEST VIRGINIA.

(Season February 1 to March 15.)

Physical properties.			Chemical analysis.					Polarizations.			Tannin reaction.	Serial number.
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.		
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
7+	Cloudy..	Rank.....	33.22	63.40	1.52	0.74	1.12	+61.60	−22.50	0	None..	6653
10	Clear....	.....do.....	31.17	64.27	2.40	.88	1.28	+61.50	−23.76	0	...do...	6990
11	...do.....	.....do.....	35.81	60.48	2.06	.85	.80	+59.00	−21.23	0	Slight.	6654
9	.....	.....	33.40	62.72	1.99	.82	1.07	+60.70	−22.50	.....	.....	
11	.....	.....	35.81	63.40	2.40	.88	1.28	+61.60	−23.76	.....	.....	
7+	.....	.....	31.17	60.48	1.52	.74	.80	+59.00	−21.23	.....	.....	

UNITED STATES.

8+	.....	.....	34.19	62.64	1.49	0.66	1.02	+60.93	−22.16	.....	.....	
16	.....	.....	48.14	70.46	10.23	1.06	4.51	+69.00	−24.97	.....	.....	
4	.....	.....	24.85	47.20	.17	.46	.00	+45.40	−17.00	.....	.....	

CANADA.

12	Clear....	Strong.....	35.18	60.98	1.56	0.71	1.57	+57.60	−22.99	0	Slight.	6822
6+	...do.....	Moldy.....	32.63	62.56	.95	.64	3.22	+59.90	−23.10	0	None..	6917
12	Cloudy..	Strong.....	36.98	60.77	.62	.52	1.11	+58.50	−22.11	0	...do...	6804
7	...do.....	Fair.....	34.48	63.06	.02	.53	1.91	+61.00	−22.66	0	...do...	6899
14	Clear....	Good.....	34.55	60.80	2.52	.74	1.39	+58.00	−22.66	0	...do...	6928
12+	Cloudy..	Poor.....	34.55	61.77	1.36	.69	1.63	+58.30	−23.65	0	...do...	6925
8	Clear....	Good.....	30.88	67.29	.75	.61	.47	+64.85	−24.42	0	...do...	6918
8	...do.....	Moldy.....	33.07	64.55	.56	.61	1.21	+62.20	23.43	0	...do...	6911
11+	Cloudy..	Mild.....	35.10	61.18	1.28	.51	1.93	+57.40	−23.76	0	...do...	6831
9+	Clear....	.....do.....	33.88	62.44	1.54	.61	1.53	+59.30	−23.54	0	...do...	6919
11	...do.....	Poor.....	34.90	60.95	1.82	.55	1.78	+58.20	−22.66	0	...do...	6930
8+	...do.....	Moldy.....	32.98	64.78	.60	.62	1.02	+62.40	−23.54	0	...do...	6914
9	...do.....	Good.....	33.02	64.85	.65	.62	.86	+62.50	−23.54	0	...do...	6913
11+	Cloudy..	Poor.....	36.25	61.36	.80	.66	.93	+58.30	−23.10	0	...do...	6904
6+	Clear....	Mild.....	34.33	62.14	1.31	.52	1.70	+58.90	−23.54	0	...do...	6934
9	...do.....	Fair.....	32.45	65.76	.73	.65	.41	+63.70	−23.54	0	...do...	6903
[a] 4+	...do.....	Mild.....	34.95	62.06	.85	.62	1.52	+59.45	−22.88	0	...do...	6933
[a] 8	...do.....	Fair.....	41.13	56.46	.82	.52	1.07	+54.55	−20.35	0	...do...	6886
8+	...do.....	Poor.....	33.06	63.77	.77	.56	1.84	+61.00	−23.60	0	...do...	6909
8	...do.....	Rank.....	33.53	64.78	.22	.63	.84	+61.30	−24.31	0	...do...	6820
10	...do.....	Poor.....	31.35	63.30	2.79	.63	1.93	+60.00	−23.98	0	...do...	6907
13	...do.....	Burnt.....	32.40	61.65	4.18	.77	1.00	+58.80	−22.99	.....	Trace.	6908
11	Cloudy..	Poor.....	34.18	63.02	1.84	.70	.26	+60.50	−23.10	0	None..	6902
9+	Clear....	.....do.....	33.63	63.96	.77	.48	1.15	+60.10	−24.75	−1.0	...do...	6827
8+	Cloudy..	Fair.....	32.13	66.06	.38	.63	.84	+63.00	−24.31	0	...do...	6818
10	Clear....	.....do.....	33.11	63.49	1.44	.63	1.30	+60.90	−23.32	0	...do...	6890
11+	Cloudy..	Poor.....	39.05	54.86	3.88	.69	1.52	+51.00	−21.78	0	...do...	6900
13	...do.....	.....do.....	34.10	62.08	1.93	.70	1.19	+58.70	−23.65	0	Trace.	6828
8	Clear....	.....do.....	33.12	64.46	.48	.57	1.37	+62.20	−23.32	0	...do...	6910
[a] 9	...do.....	Good.....	40.03	57.12	.89	.62	1.34	+54.55	−21.23	0	...do...	6887
[a] 12	...do.....	.....do.....	35.68	61.93	.98	.75	.66	+58.50	−23.65	0	...do...	6892
[a] 12	...do.....	.....do.....	34.93	62.42	1.00	.64	1.01	+59.60	−23.21	0	...do...	6893
10	Cloudy..	.....do.....	34.51	62.99	.88	.71	.91	+59.60	−23.65	−1.8	...do...	6816
[a] 10+	Clear....	.....do.....	37.38	60.22	.83	.64	.93	+58.00	−21.89	0	None..	6901
13	...do.....	Burnt.....	30.58	64.52	2.58	.64	1.68	+61.40	−24.20	0	...do...	6895

Tabulated results of maple sirup investigation, including camp and

CANADA—Continued.

Serial number and county.	Trees tapped.		Seasonal sap data.		Manufacturing data.			Run.
	Number.	Kind.	From tree.	For 1 gallon of sirup.	Buckets.	Evaporators.	Method of cleansing.	
Province of Quebec—Continued.								
6823	1,675	Hard						
6888	1,675	do						
6889	1,675	do						
6922	1,675	do						
6932	1,675	do						(a)
6832	1,675	do						
6935								
6808								
6835								
6815								
6926								
6807								
6931								
6921	700	Hard						
6912								(a)
6824								
6923								
6894								
6806								
6825								
6819								
6937								
6803								
6805								
6916	1,000	Rock						
6810								
6924								
6812								
6833								
6811								
6829								
6801								
6891								
6927								
6929								
6906								
6834								
6897								
6898								
6896								
6905	1,040	Hard						(a)
6920	1,040	do						(a)
6826								
6830								
6813								
6809								
6817								
6814								
6802								
6821								
6915		Soft						
Average (86)								
Maximum								
Minimum								

UNITED STATES AND CANADA.

Average (481)								
Maximum								
Minimum								

a Sample crystallized and was reboiled.

manufacturing data, physical properties, and chemical analysis—Continued.

CANADA—Continued.

Physical properties.			Chemical analysis.					Polarizations.				
Color.	Appearance.	Taste.	Moisture.	Sucrose (clerget).	Invert sugar.	Ash.	Undetermined.	Direct (20° C.).	Invert. At 20° C.	Invert. At 87° C.	Tannin reaction.	Serial number.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*V°.*	*V°.*	*V°.*		
8	Clear	Mild.....	32.31	64.23	1.40	0.57	1.49	+61.00	−24.20	−1.5	None.	6823
12	...do.....	Strong.....	33.36	63.39	1.21	.53	1.51	+61.00	−23.10	0	...do..	6888
12	...do.....	Fair.....	33.11	62.90	2.20	.65	1.14	+59.80	−23.65	0	...do..	6889
8	...do.....	Mild.....	37.64	60.15	.13	.63	1.45	+57.80	−22.00	0	...do..	6922
a 6	...do.....	.....do.....	42.88	54.18	1.12	.45	1.37	+52.30	−19.58	0	...do..	6932
9	...do.....	.....do.....	34.15	63.98	.47	.55	.85	+61.00	−23.87	0	...do..	6832
7	...do.....	Fair.....	33.03	64.17	.49	.54	1.77	+61.70	−23.43	0	...do..	6935
9+	Cloudy..	Poor.....	38.11	58.51	1.01	.57	1.80	+55.50	−22.11	0	...do..	6808
8	Clear....	Good.....	32.97	64.87	.35	.54	1.27	+63.50	−22.55	0	...do..	6835
11	Cloudy..	Poor.....	33.86	62.80	.80	.59	1.95	+58.80	−24.20	−1.5	Slight.	6815
12	Clear....	Good.....	31.85	65.41	1.24	.59	.91	+62.80	−23.98	0	None..	6926
12	Cloudy..	Poor.....	33.55	63.02	.85	.65	1.93	+59.40	−24.20	0	...do..	6807
12	Clear....	Fermented.	30.61	64.69	1.93	.66	2.11	+62.60	−23.21	0	Slight.	6931
7	...do.....	Good.....	35.28	64.07	.18	.51	.....	+60.50	−22.00	0	None..	6921
a 8	...do.....	.....do.....	39.38	58.65	.44	.60	.93	+56.40	−21.40	0	...do..	6912
12	...do.....	Poor.....	36.37	60.20	.69	.74	2.00	+57.30	−22.55	0	...do..	6824
8	...do.....	Mild.....	35.49	59.68	2.29	.73	1.81	+57.00	−22.17	.....	...do..	6923
13	...do.....	Strong.....	31.18	63.69	2.10	.63	2.40	+60.40	−24.09	0	...do..	6894
9	...do.....	Good.....	31.96	65.81	.36	.58	1.29	+63.10	−24.20	0	...do..	6806
11	Cloudy..	Sour.....	37.58	55.89	4.18	.64	1.71	+51.70	−22.44	0	...do..	6825
8	Clear....	Mild.....	32.68	65.22	.82	.64	.64	+62.00	−24.20	0	...do..	6819
6	...do.....	Good.....	33.23	62.37	2.48	.59	1.33	+60.30	−22.44	0	... o..	6937
12	Cloudy..	Strong.....	33.41	63.26	1.05	.66	1.62	+60.70	−23.21	0	...do..	6803
7	...do.....	Fair.....	34.45	63.36	.28	.52	1.39	+60.50	−23.54	0	...do..	6805
8	Clear....	Mild.....	33.33	65.00	.27	.56	.84	+62.80	−23.43	0	...do..	6916
12	Cloudy..	.....do.....	35.06	61.00	.90	.83	2.21	+58.70	−22.22	0	...do..	6810
13	...do.....	Poor.....	33.70	58.52	4.43	.74	2.61	+55.30	−22.33	.....	Slight.	6924
13	...do.....	.....do.....	34.66	60.88	.98	.65	2.83	+57.00	−23.76	0	None..	6812
10	...do.....	.....do.....	35.04	61.32	1.29	.66	1.69	+58.80	−22.55	0	...do..	6833
8	Clear....	Fermented.	36.81	48.34	11.01	.56	3.28	+42.10	−22.00	0	...do..	6811
13	Cloudy..	Poor.....	34.10	61.83	1.56	.77	1.74	+58.70	−23.32	0	Slight.	6829
7	...do.....	Fair.....	31.48	66.36	.31	.59	1.26	+63.60	−24.42	0	...do..	6801
9	Clear....	Good.....	31.96	65.30	.43	.57	1.74	+63.20	−23.43	0	...do..	6891
7	...do.....	Poor.....	37.15	59.32	2.26	.65	.62	+56.70	−22.00	0	...do..	6927
12	...do.....	Good.....	33.25	61.00	3.42	.62	1.71	+57.60	−23.32	0	...do..	6929
10	Cloudy..	Slight.....	35.85	61.85	.82	.72	.76	+59.50	−22.55	0	...do..	6906
13	...do.....	Poor.....	33.70	61.46	1.42	.80	2.62	+58.20	−23.32	0	Slight.	6834
9	Clear....	Mild.....	35.33	61.25	1.19	.72	1.51	+58.60	−22.66	0	...do..	6897
9+	...do.....	Fair.....	31.33	66.20	.68	.64	1.15	+63.60	−24.20	0	None..	6898
11	Cloudy..	.....do.....	31.78	65.91	.46	.69	1.16	+63.90	−23.54	0	...do..	6896
a 6+	Clear....	.....do.....	36.18	62.02	.32	.56	.92	+59.50	−22.77	0	...do..	6905
a 6+	...do.....	Mild.....	36.59	62.24	.05	.51	.61	+59.80	−22.77	0	...do..	6920
12	...do.....	Fermented.	33.88	61.78	2.42	.71	1.21	+58.30	−23.65	0	Slight.	6826
8+	...do.....	Mild.....	32.10	65.72	.42	.63	1.13	+63.10	−24.09	0	None..	6830
7	Cloudy..	Fair.....	34.68	63.61	.28	.51	.92	+60.20	−23.87	0	...do..	6813
12+	Clear....	Rank.....	35.66	54.36	7.57	.54	1.87	+48.90	−23.21	0	Slight.	6809
9	Cloudy..	Mild.....	32.17	66.39	.39	.62	.43	+63.10	−24.64	0	None..	6817
6+	...do.....	Fair.....	34.71	63.62	.00	.54	1.13	+60.10	−23.98	−1.8	Slight.	6814
9+	...do.....	Poor.....	35.33	61.03	1.28	.59	1.77	+58.40	−22.55	0	None..	6802
11	...do.....	Strong.....	33.53	61.01	3.72	.90	.84	+57.20	−23.43	0	Slight.	6821
12+	...do.....	Flat.....	31.53	66.45	1.13	.58	.31	+64.50	−23.65	0	None..	6915
10	.....	.....	34.34	62.24	1.41	.62	1.59	+59.33	−23.17	.....	.....	
14	.....	.....	42.88	67.29	11.01	.90	3.28	+64.85	−24.75	.....	.....	
4+	.....	.....	30.58	48.34	.00	.45	.00	+42.10	−19.58	.....	.....	

UNITED STATES AND CANADA.

9	.....	.....	34.22	62.57	1.47	0.66	1.08	+60.64	−22.34	.....	.....	
16	.....	.....	48.14	70.46	11.01	1.06	4.51	+69.00	−24.97	.....	.....	
4	.....	.....	24.85	47.20	.00	.46	.00	+42.10	−17.00	.....	.....	

DISCUSSION OF MANUFACTURING DATA.

CAMP DATA.

The camps varied in size from only a few trees to those containing about 9,000, the average ranging from 500 to 1,000 trees. The largest camps were found in Lewis County, N. Y., and some of 5,000 trees in Vermont. Hard, or "rock," maples were the ones generally tapped, although three samples from Maine (Nos. 6692, 6693, and 6698), one from Vermont (No. 6635), and one from Canada (No. 6915) were from soft maple. The soil varied from gravel to limestone and normal sugar-land soil.

FIG. 2.—Examples of covered buckets.

The amount of sap obtained varies considerably with the season, the tree, and the amount of foliage in the previous summer. The figures given by the makers visited ranged from 8 to 50 gallons, the average being about 15 gallons. This figure is often expressed in pounds of sugar per tree, in Vermont and Canada 2.5 pounds being the average figure, although some reported as high as 7 pounds and as low as 0.5 pound.

The length of the season varied, averaging about three weeks, covering from five to eight runs. The season of 1909 in Indiana and Ohio was unusually long, while in Vermont and Canada there was a short season of only three or four runs.

The quantity of sap necessary to produce a gallon of sirup depends on the sucrose content, 21 gallons of a sap containing 3 per cent of sugar being necessary to make a gallon of sirup, while more is required

of one containing a smaller percentage. In Ohio during the 1909 season some camps were running as high as 50 to 60 gallons of sap to the gallon of sirup. In the eastern regions 40 to 50 gallons were used, indicating a sap with 1.5 per cent of sucrose. The figure obtained in the greater number of cases varied from 30 to 40 gallons, and in a normal year this amount is sufficient.

In the older camps there were still found a good many wooden buckets, but in most cases they were being gradually replaced by metal ones. In the more recently established camps both galvanized-iron and tin buckets were used, many maintaining that the latter rust less quickly. This rusting was prevented by the more progressive makers by painting the buckets inside and out. An average of all the camps visited places the number of metal buckets used far ahead of the number of wooden ones, but remarkably few covers were used. In some sections their use is unknown, while in others they are found in the majority of cases. The following figures were obtained from the reports made in this investigation: In Indiana only 3 out of 20 makers used covered buckets; in Maine not one of the camps visited used them; in none of the 10 Massachusetts camps and in only 4 out of 22 in Michigan and in 4 out of 14 camps in New Hampshire were the covered buckets found; in Vermont only 5 out of 26 makers had a complete set of

FIG. 3.—Open buckets and too many of them.

covered buckets, and in West Virginia neither of the two camps visited used them; in New York, Ohio, and Pennsylvania the percentage is higher, namely, 23 out of 56, 24 out of 106, and 25 out of 43, respectively. So, by far the greater number of the makers, considering all sections, deemed their use superfluous, even though by keeping out the rain and snow, reducing the time of boiling, etc., the maker would soon be reimbursed for the extra expense of the covers (fig. 2).

At most of the smaller camps a sled with a covered wooden tank is used for the collection of the sap, but at nearly all of the larger ones metal vessels, especially constructed with a funnel top fitted with screens, were employed.

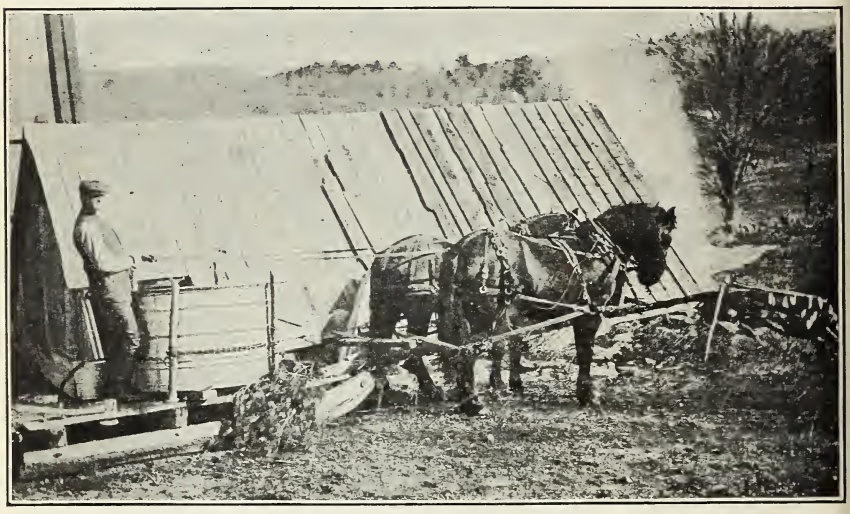

FIG. 4.—Collecting tank.

EVAPORATION OF SAP.

SAP HOUSES.

Most makers boil their sap under a simple lean-to shed, with the evaporator pans in the center, the receiving tank on one side, and a pile of dry wood on the other. Others boil the sap in the open without any covering, using pans or kettles. Only a small number have well-planned evaporation houses, though possibly these manufacture the greater part of the product, being the largest makers. In such houses the sap is received in an outside tank connecting with the evaporator on the inside by a rubber hose. The best arrangement seen had the fire-door opening on the other side of a partition, which prevented ashes or smoke from getting into the boiling sirup when firing. Nearly all of the houses visited had chimneys and openings in the roofs for the escape of the steam.

THREE KINDS OF EVAPORATING APPARATUS.

The storage tanks at the evaporation houses were wooden in over 50 per cent of the cases and metal in the others, with a capacity varying from 100 to 400 gallons. The evaporation equipments observed may be divided into three general classes: (1) Iron kettles or pans; (2) arch evaporators; (3) patent evaporators.

Iron kettles or pans.—The camps equipped with kettles or pans generally boiled in the open in kettles from 2 to 4 feet in diameter, placed as previously described, while a few used iron pans, in which the fire box was dug out of the ground and sometimes bricked up on the sides of the pit, with a row of bricks on top of the ground. The pans generally were 2 by 3 or 3 by 6 feet and rested on this layer of bricks. Some of the largest makers used a few iron pots in connection with their evaporators, but these were only employed in an emergency to handle an extra heavy run of sap.

Arch evaporators.—In all cases this outfit was placed in a shed. The evaporator itself was a pan, generally of sheet iron, or in a few cases two or more pans on the same arch, which were placed on two rows of brick or stone walls about 4 feet apart, 3 feet high, and from 8 to 15 feet long. At one end a chimney of the same material was erected, just clearing the roof. The pans fitted on top of the walls and formed an arch, hence the name "arch evaporators." In the majority of cases the brick or stone walls were of loose construction, with mud between the cracks and crevices, so that smoke quite often issued from the numerous holes. Generally the front of the arch was covered with a piece of sheet iron, or in some cases with a regular galvanized-iron front having doors.

Patent evaporators.—Many forms of patent evaporators were found in use, some of which were more common than others. Generally they consisted of a heavy iron arch or fire box from 3 to 4 feet wide and from 10 to 15 feet long, open on top, with a stack at one end and the fire and ash doors at the other. Some of the evaporators were as large as 6 by 24 feet. Fitted on top of this compact iron furnace or arch were the pans of tin plate divided into compartments, and in some cases on the back toward the chimney were several separate small pans in which the product was finished. Some had an apparatus for automatic feeding on the side, which also maintained a constant level. The sap entered there and ran a zigzag course over the fire, siphons being used to pass the sirup over the walls.

In some sections a large number of makers used either the arch or patent evaporators, but it was a mooted question as to which of the two produced the better sirup; that is, one of lighter color and more pleasant flavor. Beyond doubt the patent evaporators have all

the points of construction necessary to make a good sirup, but the success of the run depends to a greater extent on the operator. Many samples obtained from arch evaporators were as light colored and as mild in flavor as those from the patent evaporator; but, as a general rule, those from iron kettles were dark in color and strong.

Summarizing the reports of the makers on this subject, the following data were obtained for the individual States:

Types of evaporators used in the various States.

State.	Patent.	Arch or iron pans.	Iron kettles.	Steam pans.
Indiana	12	5	3	.....
Maine	4	2	2	.....
Massachusetts	6	4	0	.....
Michigan	11	10	1	.....
New Hampshire	12	2	0	.....
New York	22	33	0	6
Ohio	62	16	27	3
Pennsylvania	30	16	3	.....
Vermont	22	3	1	.....
West Virginia	1	1	0	.....
Total	182	92	37	9

It is seen that the patent and the arch evaporators are used almost without exception in all the States except Ohio, where quite a number of iron kettles are still in use, the patent evaporators exceeding those of the arch type, especially in Ohio, Pennsylvania, and Vermont.

CLEANSING AND STRAINING.

The sap as it comes from the trees in the first run is water white, but toward the last, under ordinary conditions, it becomes greenish or yellowish and apparently thicker. The percentage of sugar obtained varies considerably in the case of the individual trees and with the varying climatic conditions from year to year. The sap is almost a pure sucrose solution, the percentage of nitrogenous matter being very small. An average sucrose content of sap based on 225 determinations is approximately 2.83 per cent, the average for total solids in 50 analyses being 3.9. Invert sugar is practically absent in the earlier runs and present in the last runs in very small quantities, if at all. Starch has never been found in the sap. The ash varies considerably; an average given by Wiley based on 22 samples is 0.146 per cent.[a]

When the sap is boiled, the nitrogenous matter tends to coagulate, forming a scum on the surface of the boiling liquid, which must be continuously skimmed off in order to obtain a clear sirup. It is noted, when boiling maple sirup, that upon every addition of fresh sap there is a violent ebullition of gas which throws the sediment to the top, and quite a number of makers add it in small quantities with that end in

[a] U. S. Dept. Agr., Bureau of Chemistry Bul. 5, p. 210.

view. In small amounts this addition may not darken the sirup, but in large quantities it does, as the time of boiling is lengthened, and the constant thickening and diluting of the liquid destroys some sugar and organic matter. The coagulum or scum contains, besides the nitrogenous matter, some mineral salts, mostly lime salts and suspended dirt. On further evaporation or boiling, the mineral salts of the sap become concentrated, and when the point of supersaturation is reached these are partly deposited on the sides and bottom of the evaporator, the remainder being held in suspension in the thick sirup. This deposit, known as "sugar sand," "niter," "silica," etc., consists for the most part of a malate of lime. Two analyses of crude niter are given, one of an Indiana sample and the other of a sample collected during this investigation.

Two analyses of crude niter.

Determination.	Sample No. 1.[a]	Sample No. 2.
	Per cent.	*Per cent.*
Water	6.11	2.61
Insoluble matter	9.13	1.66
Reducing sugars	12.74	21.28
Sucrose	26.88	32.58
Calcium	12.89	12.13
Malic acid	20.86	27.97
Potassium	.72	Trace.
Protein	.40	.....
Magnesium	Trace.	.....

[a] Twelfth Ann. Report of the Indiana Agricultural Experiment Station, 1899, p. 74.

The quantity of deposit varies in different years, and also there is usually a larger deposit late in the year than at the beginning of the season. The different methods and means to which makers resort for removing this suspended matter and scale, and thus cleansing the sirup, are discussed in the following paragraphs.

Among the makers visited opinions differed widely as to the need of adding cleansing substances. As has been mentioned, some of the impurities are coagulable by heat and rise to the surface while the sap is boiling, and the excess of ash is precipitated on concentration, either being deposited on the boiling apparatus or remaining in suspension. The large makers simply filter the sirup through felt or cloth bags before boiling is completed and again after it is brought to the desired density and is still hot, which removes the finely divided sediment. At a large percentage of the camps, however, some cleansing agent, such as milk or white of egg, was used. In most of the cases where these were used the thin sirup was taken from the evaporators when weighing about 8 or 10 pounds to the gallon, cooled, and the cleansing substances added, after which the thin sirup was boiled down in small lots to the desired consistency.

In other instances these substances were added to the thickening sirup without stopping the process. The two methods seem to yield the same results. The addition of this material brings the scum to the surface, where it is skimmed off constantly. It is claimed by many makers that this procedure is necessary if a fancy sirup is to be made, but a larger percentage of the clear sirup samples came from those using neither milk nor eggs. The use of these materials is a tradition among some makers, and few have ever tried to produce a clear sirup by any other means. It is also claimed that the color of the product is lightened by their use, a point which was hardly substantiated by the data collected (see p. 95).

A few makers use baking soda and saleratus in boiling the sap. This tends to neutralize the acidity of the juice, but has no cleansing effect. When boiling fermented or sour sap its use is beneficial in neutralizing the acidity, and thereby preventing further inversion of the sucrose. Its excessive use, however, is likely to change the color of the sirup, as any alkaline sugar juice when boiled turns dark. The popular application of the term "sour sap" is to one differing in appearance from the normal; it does not necessarily mean a sap with an increased acidity. One hears of milky sap, stringy sap, red sap, and at the end of the season green sap and yellow sap. Edson [a] has shown that the acidity of these changed saps is not much greater than that of the normal. His work on the bacterial flora of the sap has shown that the different forms of sour sap are due to different bacteria, and these do not increase the acidity materially. Under such conditions, the addition of the soda would hardly be more necessary than with a normal sap. However, there are forms of souring that do produce an increase of acidity, and in such cases soda would improve the product by preventing further inversion of the sucrose. Again some run a piece of fat meat over the surface to keep down the excessive frothing or place a little lard in the boiling pan or kettle. These practices may have to be resorted to occasionally, but they are not generally advisable, as the flavor is greatly changed if the application has been made often. In general, the use of any chemical substance as a cleanser is superfluous and expensive.

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[a] Vermont Agricultural Experiment Station Bul. 151.

Summarizing the results from the investigation on this point it appears that the usage is as follows:

Use of cleansing agents in the various States.

State.	Makers using—	
	Milk and eggs.	No cleansing agent.
Indiana	4	16
Maine	1	7
Massachusetts	1	9
Michigan	11	10
New Hampshire	0	14
New York	37	24
Ohio	20	88
Pennsylvania	3	34
Vermont	6	24
West Virginia	1	1
Total	84	227

About 27 per cent of the total number of makers interviewed were using cleansing agents, and nearly half of these were in New York, about a quarter in Ohio, and one-eighth in Michigan. Only 18 per cent of the Ohio makers were using cleansers, according to these figures, 60 per cent of the New York makers, and 52 per cent of those in Michigan.

Among the 227 makers not using these agents the procedure generally adopted was to strain the product as often as possible. The strainer in most cases was a heavy felt cloth to remove the very fine material, and linen or flannel to remove the coarse sediment. Some makers strain as many as six times before the sirup is finished, from the bucket into the collecting tank, from this tank to the storage tank, and sometimes again on its way to the evaporator; then the thin sirup is strained, also the thick sirup, and a final straining is given as the finished product goes into the cans. Undoubtedly the oftener the product is strained the better its appearance and taste. The scum as it comes to the top in boiling should be carefully removed with a flat scoop. Removing the fine sediment or malate by continuous, careful skimming, and settling will yield a bright, clear sirup. The skimmings from sirup manufacture are used for various purposes. Some make vinegar from them and some introduce the clear supernatant liquid, after long settling, into the fresh sap, but those who make maple sugar at the same camp generally turn them into sugar.

Many makers use acid such as muriatic acid (hydrochloric) or vinegar to remove the scale that has collected on the sides and bottom of the evaporators, some scrape it off, and others reverse the course of the sap. The scale being principally a lime salt is easily dissolved by any weak acid, but the greatest care must be taken to remove every trace of the acid used for this purpose from the evapo-

rator so that it will not get into the sirup, invert the sucrose, and change the flavor. For this reason its use can not be recommended. Scraping must be done with care so that the walls or bottom of the evaporator will not be injured. Even a slight flaw in the metal will cause the evaporator to give way at that place very easily. Many makers, in fact nearly all of those using pans, remove the scale by starting the sap into the pan in the opposite direction to that of the day before, as the greatest deposit is in the sirup end of the pans. The movement of the sap tends to loosen the scale and dissolves some of the mineral substance. Other makers find that the scale is easily taken off by simply boiling water in the receptacles. In one way or another the scale should be removed because it lengthens the time of boiling and darkens the sirup. The latter change is brought about partly by the organic matter held by the scale being brought to a higher temperature than that of the liquid and causing decomposition. The scale is of no commercial value but many collect it and use it for scouring.

CANNING, STORAGE, AND SALE.

Maple sirup among the small makers is generally stored and shipped in tightly sealed milk cans holding many gallons or it is put up in gallon and half-gallon cans having screw tops. A few of the larger makers ship in barrels or kegs. The sirup coming from the final boiling is allowed to pass through felt bags hung generally in milk cans. The sirup is drawn off from below and usually is canned when it is almost or quite cold. After the cans are filled and the caps tightly adjusted they are stored in cool cellars or sheds and under such conditions the sirup should, and does, keep for many years, especially if the thickening has been carried to the proper point (see p. 60).

The farmers generally have their own customers, to whom they dispose of their extra sirup, which brings from 80 cents to $2 a gallon, depending on the year's output and the grade of the product. Other farmers combine and sell their sirup to local consumers, grocers, brokers, or maple sugar companies. The price in this case is lower, varying from 50 cents, and sometimes less, to $1.50 a gallon, this maximum figure being rarely reached. These brokers or middlemen in former times had a set price per gallon for sirup, whatever the grade, but now most of them offer more for the lighter-colored sirups, the price decreasing as the color increases. For instance, if $1 is paid for a sirup with a color number of 5, 6, and 7, then Nos. 8, 9, and 10 would bring about 90 cents, Nos. 11, 12, and 13 about 80 cents, and Nos. 15 and 16 about 65 or 70 cents. Besides being light in color, the sirup must be as heavy as the darker products as the broker's price is regulated also by the density of the product. A sirup of standard commercial density brings the regular price, which is proportionately

Bul. 134, Bureau of Chemistry, U. S. Dept. of Agriculture.

STANDARD COLORS BY WHICH THE SYRUPS WERE GRADED.

A. Hoen & Co. Baltimore

decreased as the density falls. The flavor also enters into the valuation of the sirup.

A great many buyers classify all purchases under three grades according to the following color scale: Grade A1 or AA (color Nos. 6, 7, 8, and 9); Grade A (Nos. 10, 11, and 12); and Grade B (Nos. 13, 14, 15, and 16).

In buying, some of the brokers require farmers to sign guaranties worded somewhat as follows: "I hereby guarantee the maple sirup sold you to-day to be absolutely pure; made only from the sap of the maple tree with no additions whatever except such as might be used for cleansing." This is a comparatively recent procedure and may in part be traced directly to the Food and Drugs Act. At the farmers' camps visited very little adulteration was noted or even suspected. If any suspicious facts were observed, the samples collected were marked and the analytical results were not entered in the general table.

DISCUSSION OF PHYSICAL AND CHEMICAL DATA.

COLOR.

The color varies from that of a very light water-white to a very dark reddish brown. On the scale mentioned on page 15 and pictured in the illustration (Pl. I) the colors vary from 4 (the lightest) to 16 (the darkest). Considered by States, the averages are for Indiana, 10+; Maine, 8+; Massachusetts, 7; Michigan, 8+; New Hampshire, 8; New York, 7; Ohio, 8; Pennsylvania, 8; Vermont, 9; and West Virginia, 9, giving an average for the United States of 8+. The plus sign after a figure means that the color was darker than the number indicates but lighter than the next number. The data recorded (p. 93) show that the middle run is about the same in color as the first but the last runs are darker.

Tabulating the results on color determinations by States and grouping the samples in each State under the appropriate color number it is seen that in most cases the largest number of samples have a color of 8 or 9, though there are exceptions. In the United States 76.8 per cent of the samples have a color lighter than No. 10, while in Canada only 52.5 per cent possess these lighter colors, 31.2 per cent of the Canadian samples having a color of Nos. 11 and 12, while only 10.7 per cent are so classified in the United States. Of the total 481 samples about 73 per cent have a color lighter than No. 10.

Color of samples grouped by States.

Color.	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	United States.		Canada.		Total.	
											Total.	Per cent.	Total.	Per cent.	Number.	Per cent.
4	....	....	....	....	1	....	.....	....	....	....	1	0.3	1	1.2	2	0.4
5	....	....	....	1	2	3	4	2	....	....	12	3.0	....	.....	12	2.5
6	....	....	3	....	....	12	19	8	5	....	47	11.9	7	8.1	54	11.2
7	1	2	3	4	2	24	24	12	10	1	83	21.0	7	8.1	90	18.7
8	5	3	4	6	4	15	36	19	4	....	96	24.1	17	20.0	113	24.1
9	5	1	....	4	3	10	26	7	9	....	65	16.5	13	15.1	78	16.0
10	1	....	....	3	....	....	15	2	8	1	30	7.6	6	7.0	36	7.5
11	2	....	....	2	2	2	4	....	9	1	22	5.6	9	10.5	31	6.4
12	5	1	....	2	1	....	5	3	3	....	20	5.1	18	20.7	38	7.9
13	2	1	....	1	....	....	3	2	1	....	10	2.6	7	8.1	17	3.3
14	....	1	....	....	....	....	4	....	1	....	6	1.5	1	1.2	7	1.4
15	....	....	....	....	....	....	1	....	....	....	1	0.3	....	.....	1	0.2
16	2	....	....	....	....	....	.....	....	....	....	2	0.5	....	.....	2	0.4
Total	23	9	10	23	15	66	141	55	50	3	395	.....	86	.....	481	100.0

FLAVOR.

The flavor of maple sirup is peculiar to itself. Tasters and judges classify the flavor as mild, strong, buddy, and molasses-like. Some speak of the strong flavor as being "woodsy" in distinction from the true mild flavor of the clean, pure maple sirup. A great many users of sirup, however, prefer this "woodsy" taste, which is generally characteristic of the sirup made by boiling down in the open, in iron kettles, the sap collected in wooden buckets. Some have described the sirup coming from one section as being milder or stronger than that from other sections, and the products of the colder northern regions, as Canada and Vermont, as being different from the sirup made in the warmer regions of Ohio and Pennsylvania. In this investigation such sectional distinctions were not observed. The flavors said to be characteristic of certain regions seem to be due to the manner of collection of sap and the manufacture of the sirup rather than to peculiarities of the sap of the locality. Just as mild a sirup was obtained in Canada and Vermont as in Ohio, and the reverse also was true, the product varying with the method of production and manufacture rather than with the locality.

MOISTURE CONTENT.

The average figure for moisture content in the 395 samples from the United States was 34.19 per cent. This figure includes the 71 samples that were reboiled by the laboratory on account of crystallization; excluding these samples the average of the remaining 324 samples becomes 33.87 per cent. The range of variation in the original samples, whether the reboiled samples were included or not, was from 24.86 to 48.14 per cent. The following table shows what

proportion of the samples collected complied with the two moisture requirements specified:

Percentage of samples complying with two maximums of moisture content.

State.	Number of samples.	Per cent of samples containing not more than—	
		32 per cent water.	35 per cent water.
Indiana	23	35	61
Maine	9	22	78
Massachusetts	10	40	70
Michigan	17	29	53
New Hampshire	13	00	61
New York	45	40	80
Ohio	126	28	75
Pennsylvania	33	24	94
Vermont	46	29	56
West Virginia	2	50	50
United States	324	29	72

The average shows that only 29 per cent of the samples collected would comply with the 32 per cent requirement, while if 35 per cent were considered the maximum then 72 per cent of the samples would be satisfactory in this particular.

A sirup that is made too thin will not keep because of fermentation, while if too thick the sucrose will crystallize. Of the 395 samples collected within the United States 71 were crystallized to such an extent that they could not be analyzed, the liquid above the crystals showing a moisture content of less than 32 per cent in most of the cases. Of the remaining 324 samples 45 had crystallized somewhat and their moisture content was as follows:

Moisture content of 45 samples showing slight crystallization.

State.	Serial No.	Water.	State.	Serial No.	Water.	State.	Serial No.	Water.
		Per ct.			*Per ct.*			*Per ct.*
Indiana	6248	31.51	Ohio	6310	27.08	Ohio	6650	28.68
Do	6396	32.23	Do	6400	29.73	Do	6333	31.96
Do	6241	31.51	Do	6381	31.87	Do	6330	31.86
Do	6244	29.41	Do	6273	31.53	Do	6311	30.09
New Hampshire	6680	32.50	Do	6265	31.71	Pennsylvania	6885	31.11
New York	6524	31.72	Do	6285	30.34	Do	6407	34.05
Do	6583	30.60	Do	6271	32.28	Do	6417	32.35
Do	6539	32.35	Do	6281	31.69	Do	6418	30.96
Do	6536	31.85	Do	6294	32.23	Do	6408	33.75
Do	6582	32.45	Do	6295	30.44	Do	6403	33.25
Do	6593	29.25	Do	6282	31.09	Vermont	6739	31.70
Do	6531	31.02	Do	6283	30.89	Do	6741	31.95
Do	6541	30.40	Do	6268	24.85	Do	6768	31.35
Do	6535	31.60	Do	6287	31.84	Do	6782	30.98
Ohio	6443	31.73	Do	6272	31.68	Do	6773	29.85

It is seen that sirups with as high as 34 per cent of water in one case, 33 per cent in two cases, and 32 per cent in seven cases had crystallized, while none with 35 per cent had crystallized. Crystal-

lization is reduced by the presence of certain mineral salts and organic bodies and also by the invert sugar content. According to Herzfeld, a saturated solution of pure sucrose at 15° C. contains 66.33 per cent of sugar and at 64° C., 74.98 per cent. Prinsen Geerligs states that at 18° C. a saturated solution contains 67.1 per cent and at 27° C., 68.8 per cent of sucrose. The average maple sirup with 34.19 per cent of water contains 62.64 per cent of sucrose, and calculated to a 32 per cent water basis this figure would be 64.73 per cent, a sucrose content which would probably not be accompanied by crystallization at ordinary spring or summer temperatures, but would permit it at the lower temperature which is likely to exist at the time the sirup is made and stored. The table shows that one sample with a 34 per cent water content had crystallized and the supernatant liquid of some of the other fully crystallized sirups had a water content of from 33 to 34 per cent, which would indicate that 68 per cent of dry substance was too high and that 65 per cent represented a more desirable composition.

The makers of maple sirup have various methods of determining the thickness or density of the sirup, some of which are scientific and some are not. A special hydrometer and thermometer are sometimes employed and again the appearance of the boiling sirup, the way in which the last drops fall from a spoon or cup, the quality and strength of the sirup film, and the weight of a gallon are used as a test of density.

With a maximum content of 35 per cent water, the specific gravity is 1.31989 at 17.5° C. or 35.6° Baumé, and 1 gallon (231 cubic inches) weighs 11 pounds. With a maximum content of 32 per cent water, the specific gravity of such a sirup is 1.33836 at 17.5° C. or 37.1° Baumé, and 1 gallon weighs 11.15 pounds or 11 pounds 2½ ounces. When determining the density of a sirup by actual weight the makers fill the gallon can and weigh, allowing half a pound for the weight of the can. Care should be taken to insure that the can holds an exact gallon, that the weight of the empty can is obtained, and that the sirup is cold or has a temperature of about 63° F. Only under these conditions will the exact weight of a gallon of sirup be obtained. When using the temperature of boiling as a means of determining the water content or density, there are numerous points to be considered. The Vermont experiment station has found that a maple sirup boiling at 219° F.[a] weighs 11 pounds to the gallon or contains 35 per cent of water, and one boiling at 221° F. weighs 11.2 pounds and contains 32 per cent of water. These boiling temperatures are for places at or near sea level. Every 500 feet of elevation lowers the boiling point 1° F. approximately. To determine the density

[a] This figure is for a middle run sirup; with the first runs of sap a sirup of 65 per cent of dry substance may boil at from 217° to 218° C.

by this method the thermometer must be accurate and must be held in the boiling liquid so that it does not touch the sides of the metal evaporator or pan. A good rule for the maker to follow when using a thermometer is to test it in boiling water and note the temperature; the sirup should boil at a temperature 7° higher than that of boiling water if it contains 35 per cent of water, or 9° higher if 32 per cent of water is present.

A hydrometer or Baumé spindle should never be placed in boiling sirup as this destroys the accuracy of the instrument. Only cold sirup should be tested by this method, especially when the ordinary glass hydrometer is used; a metal one is not so much affected by heating. The diameter of the vessel containing the sirup should be at least 2 inches, so that the spindle does not come in contact with the sides. For 35 per cent of moisture, the Baumé reading is 35.6° and for 32 per cent of moisture 37.1° B. In Canada the imperial gallon (277.274 cubic inches) is the standard and hence maple sirup there must weigh 13 pounds and 2 ounces for a water content of 35 per cent.

SUCROSE.

The average figures for the sucrose determination in the United States samples is 62.64 per cent, in the Canadian samples 62.24 per cent, the average of all being 62.57 per cent. Reducing these figures to the dry basis it is seen that sucrose constitutes about 95 per cent of the solid matter, amounting approximately to 95.2, 94.8, and 95.1 per cent for the three groups mentioned. The variations in the sucrose content range from 47.20 to 70.46 per cent for the United States samples alone. Generally a low sucrose content is accompanied by a high reducing sugar content, indicating that the sirup has fermented or has been prepared from sour sap.

INVERT SUGAR.

The method followed for making this determination takes into consideration the reducing action of sucrose on the alkaline copper solution, otherwise the quantity of reducing sugars as determined would contain a large positive error. The extreme figures for this determination are zero and 11.01 per cent, the latter representing a fermented sirup. The average was 1.47 per cent of invert sugar. About 53 per cent of the sirup samples contained less than 1 per cent of invert sugar, as shown in the following table:

Invert sugar content of maple sirups.

Invert sugar.	Number of samples.	Per cent of total number of samples.
Per cent.		
11.00 and over.	1	0.2
10.00 to 10.99	1	.2
9.00 to 9.99	2	.4
8.00 to 8.99	2	.4
7.00 to 7.99	4	.8
6.00 to 6.99	2	.4
5.00 to 5.99	9	1.8
4.00 to 4.99	12	2.5
3.00 to 3.99	22	4.5
2.00 to 2.99	48	10.0
1.00 to 1.99	121	25.2
0.50 to 0.99	172	35.9
0.00 to 0.50	85	17.7

The fact that over half of the sirups contained less than 1 per cent and only one-tenth of them had over 3 per cent of invert sugar, one having none, suggests that large quantities of reducing sugars are abnormal and indicate carelessness in manufacture. Their presence comes from inversion of the sucrose during either the souring or concentration of the sap or results from the fermentation of the finished sirup. Published analyses of sap have in only a few cases shown reducing substances present, but it is doubtful whether the samples examined were fresh and perfectly sweet and whether allowance was made for the reducing action of the sucrose. If the 21 fermented samples containing over 5 per cent of invert sugar are disregarded an average figure of 1.2 per cent of invert sugar is obtained. Holding these samples in cold storage through the summer did not increase the percentage of invert sugar when the sirup was boiled down to a water content of 34 per cent and lower.

As to the composition of the reducing sugars it is seen from the average analysis of the United States samples that there is present about 1.49 per cent and the difference between the Clerget sucrose and that determined by the direct polarization is 1.71 per cent. The average of all samples shows 1.47 per cent of invert sugar present and a difference between the two sucrose determinations of 1.93 per cent. In these cases, then, 1 per cent of reducing sugars neutralizes 1.14 and 1.31 per cent of sucrose at 20° C., respectively. Since 1 per cent of invert sugar at 20° C. neutralizes 0.301 per cent of sucrose, while 1 per cent of levulose in a 2 per cent levulose solution neutralizes 1.38 per cent of sucrose, this would seem to indicate that the reducing sugars present are nearly all levulose. If the percentage of reducing sugar is high, however, these facts are not so noticeable as when it is low, as is shown in the following table. The lower the reducing sugar content (as invert), apparently the higher the 1 per cent sucrose equivalent. This would seem to indicate that there is a levorotatory

substance present other than levulose, which as yet has not been identified.

Comparison of amounts of sucrose equivalents of 1 per cent of reducing sugar when large and small amounts are present.

LARGE AMOUNTS OF REDUCING SUGAR.

Serial No.	Reducing sugar (calculated as invert).	Difference in sucrose by Clerget and by direct polarization.	Sucrose equivalent of 1 per cent reducing sugar.
	Per cent.	*Per cent*	*Per cent.*
6496	5.85	2.93	0.50
6242	7.00	3.79	.54
6473	5.95	2.00	.34
6725	9.03	5.96	.66
6778	10.23	3.84	.37
6811	11.01	6.24	.57
6809	7.57	5.46	.72
6908	4.18	2.85	.68
6855	9.37	5.50	.59

SMALL AMOUNTS OF REDUCING SUGAR.

6240	1.14	1.98	1.73
6463	1.07	1.83	1.71
6514	1.72	2.54	1.48
6512	1.00	1.78	1.78
6670	1.05	2.14	2.04
6478	1.19	2.11	1.77
6366	1.11	2.87	2.58
6371	1.10	1.42	1.29
6283	1.06	2.54	2.40
6253	1.10	1.75	1.59

UNDETERMINED MATTER.

This figure is obtained by difference and hence is more or less influenced by the accuracy of the other determinations. The highest figure noted was 4.51 per cent and the lowest was zero, while in 32 samples the sum of the determined data is above 100 per cent, the greatest excess being 0.73 per cent. The average undetermined matter amounts only to 1.08 per cent. Assuming that the ash, as weighed, is in the carbonate form and that such carbonates come from the breaking down of the malic acid, supposed to be the principal acid present, a part of the undetermined matter, in fact nearly three-quarters of it, would be accounted for in the transition of the 1 per cent of average ash from the carbonate to the malic-acid stage.

POLARIZATIONS.

The average of the direct polarizations of all the samples is +60.64° V.; the extremes are from +69.00° V. to +42.10° V. In the invert polarization, the average is −22.34° V., while the extremes are −24.97° V. to −17.00° V. Out of the 481 samples 23 showed a

rotation when the invert solution was polarized at 87° C., the results being as follows:

Polarization of 23 samples of maple sirup, showing rotation at 87° C.

Serial No.	Polarization.	Serial No.	Polarization.	Serial No.	Polarization.
	° *V.*		° *V.*		° *V.*
6397	−0.4	6364	−1.8	6425	−0.6
6713	−1.5	6306	− .6	6429	−2.4
6538	− .2	6304	+1.0	6827	−1.0
6535	− .4	6303	−1.0	6816	−1.8
6440	−2.0	6353	−1.0	6823	−1.5
6441	−1.8	6361	− .8	6815	−1.5
6442	−1.2	6362	+ .6	6814	−1.8
6400	− .6	6426	−2.0		

Only two samples showed plus or dextro rotation, the remainder being negative or levorotatory. To test these observations the verniers and scales were set at 0° and a reading made when the temperature of the solution had reached 87° C. If the field was of even color, no rotation was indicated and two or three check readings were made. If the field showed a different color, a reading was made in the usual way.

TANNIN BODIES.

The ferric chlorid test showed the presence of tannin in 29 of the 481 samples. In only one case was the reaction very marked, although in others there was a strong indication of the presence of tannin. In all but four cases the color of the samples was darker than No. 10 of the color scale; the greater number ranging from No. 13 to No. 14. The exceptions are one sample with the color of No. 6+, two with that of No. 9, and one like No. 7. Tannin is not a normal constituent of maple sirup; it probably comes into the sap from the washings of the tree and may be taken out with the scum. If a sap containing tannin comes in contact with an iron surface, as in boiling in kettles, it generally yields a dark-colored sirup.

THE ASH.

The highest per cent of ash in the United States samples, as collected, was 1.06 and the lowest 0.46, the average being 0.66 per cent. On the 481 samples, including Canada, both this average and the extremes remained unchanged. The 0.46 per cent of ash was determined on sample 6680 from New Hampshire, which in all other particulars seemed to be pure. The water content of this sample was 32.50 per cent and, calculating the ash to the dry basis, the result is 0.68 per cent.

TABULATION OF MOISTURE-FREE DATA.

In the following table are assembled those determinations which are considered as especially indicative of the character of a maple sample, namely, the ash figures calculated to a water-free basis, including the soluble and insoluble ash, their alkalinity and their relation to each other, the lead number, and the malic-acid value:

Ash data, lead number, and malic-acid value.[a]

[Calculated to a moisture-free basis.]

INDIANA.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Clinton County:											
6493	0.98	0.63	0.35	1.80	79	89	0.88	2.42	0.81	0.84	1.04
6495	1.04	.74	.30	2.46	104	90	1.15	3.08	.80	.78	.99
6496	1.25	.79	.46	1.82	107	130	.82	3.89	1.13	1.20	1.39
6497	1.04	.46	.58	.79	82	145	.57	3.30	.59	.99	1.11
6492	.88	.52	.36	1.44	63	73	.86	3.00	.52	.70	.85
6494	1.68	.84	.84	1.00	82	184	.44	3.78	.95	1.31	1.57
Hendricks County:											
6246	1.53	.79	.74	1.07	43	208	.21	3.59	1.53	1.06	1.78
6247	1.08	.70	.38	1.84	71	130	.54	2.74	.99	.55	1.16
6248	.96	.61	.35	1.75	87	94	.92	2.98	1.03	.81	1.06
Huntington County:											
6323	1.21	.75	.46	1.63	82	124	.66	2.93	1.21	.68	1.03
6474	1.10	.68	.42	1.62	79	94	.84	2.54	.94	.97	1.19
Madison County:											
6398	1.54	.57	.97	.58	78	195	.40	3.32	.75	1.21	1.51
6396	1.09	.63	.46	1.37	73	94	.77	2.77	.87	.90	1.10
6397	1.25	.66	.59	1.13	90	116	.77	3.20	1.04	1.05	1.28
6395	1.32	.74	.58	1.28	106	111	.95	3.16	.95	1.03	1.25
6399	1.65	.77	.88	.88	103	187	.55	4.05	1.42	1.49	1.75
Putnam County:											
6239	1.25	.77	.48	1.60	77	161	.47	3.31	1.41	.60	1.47
6240	1.06	.77	.29	2.65	86	97	.88	2.64	1.02	.41	1.08
6241	1.05	.68	.37	1.84	76	121	.62	2.82	1.34	.61	1.00
6242	.99	.63	.36	1.75	68	113	.60	2.49	.90	.45	1.02
6243	1.06	.66	.40	1.65	70	126	.55	2.64	1.13	.70	1.15
6245	.87	.64	.23	2.78	75	81	.93	2.32	.97	.66	1.00
6244	.90	.62	.28	2.20	65	97	.67	1.91	.76	.46	.86
Average (23)	1.16	.68	.48	1.42	80	124	.65	3.00	1.00	.85	1.20
Maximum	1.68	.84	.97	2.78	107	208	1.15	4.05	1.53	1.49	1.75
Minimum	.87	.46	.23	.58	43	73	.21	1.91	.52	.41	.85

MAINE.

Franklin County:											
6698	1.35	0.63	0.72	0.87	81	144	0.56	2.05	1.02	0.98	1.25
6695	1.20	.65	.55	1.18	78	129	.60	2.55	.85	1.06	1.20
6696	.90	.60	.30	2.00	83	80	1.03	2.09	.74	.78	.90
6697	1.24	.61	.63	.97	81	145	.55	3.18	1.06	1.20	1.48
Oxford County:											
6694	.92	.61	.31	1.97	65	94	.69	2.12	.62	.79	.91
6693	.97	.71	.26	2.73	68	67	1.01	1.76	.20	.32	.31
6692	1.01	.77	.24	3.20	72	44	1.63	2.36	.29	.41	.44
Penobscot County:											
6713	1.27	.76	.51	1.50	101	100	1.01	2.70	.89	.97	1.16
6714	.96	.59	.37	1.60	80	63	1.27	2.13	.64	.63	.83
Average (9)	1.09	.66	.43	1.51	79	96	.82	2.33	.70	.79	.94
Maximum	1.35	.77	.72	3.20	101	144	1.63	3.18	1.06	1.20	1.48
Minimum	.90	.59	.24	.87	65	44	.55	1.76	.20	.32	.31

[a] By referring to the corresponding serial numbers in the table beginning on page 20 a complete record of any sample may be obtained.

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

MASSACHUSETTS.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Berkshire County:											
6574	0.94	0.62	0.32	1.93	79	97	0.81	2.99	0.80	0.94	1.08
6573	.81	.57	.24	2.37	75	76	.98	2.03	.63	.78	.83
6572	.82	.59	.23	2.56	86	66	1.30	2.40	.76	.85	.89
Franklin County:											
6616	.91	.66	.25	2.64	87	108	.81	2.18	.79	.80	.96
6613	.88	.65	.23	2.82	73	57	1.28	1.85	.70	.67	.79
6615	1.27	.80	.47	1.70	77	131	.58	2.99	1.00	1.16	1.32
6614	.86	.58	.28	2.07	61	83	.73	1.93	.58	.75	.88
Hampden County:											
6505	.96	.50	.32	1.56	75	41	1.83	2.16	.54	.55	.68
6504	1.12	.73	.38	1.92	95	95	1.00	3.19	.49	1.09	1.14
6506	.99	.70	.29	2.41	96	77	1.25	2.87	.89	.99	1.05
Average (10)	.95	.64	.31	2.06	80	83	.96	2.46	.72	.86	.96
Maximum	1.27	.80	.47	2.82	96	131	1.83	3.19	1.00	1.16	1.32
Minimum	.81	.50	.23	1.56	61	41	.58	1.85	.49	.55	.68

MICHIGAN.

Branch County:											
6451	0.91	0.64	0.27	2.37	67	79	0.84	2.32	0.55	0.68	0.81
Eaton County:											
6461	1.02	.64	.38	1.68	61	121	.50	2.80	.66	.80	1.23
6462	.89	.57	.32	1.78	61	95	.64	2.00	.36	.68	.92
6463	.99	.64	.35	1.82	66	120	.55	2.72	1.11	.88	1.14
Ingham County:											
6453	.81	.58	.23	2.52	73	70	1.04	2.04	.30	.61	.77
6454	.82	.59	.23	2.57	75	75	1.00	2.27	.49	.69	.95
6455	1.14	.86	.29	2.96	89	75	1.18	2.78	.61	.67	.87
6444	.98	.62	.36	1.72	70	113	.62	2.74	.62	.86	1.13
6456	1.01	.75	.26	2.88	81	81	1.00	2.89	.70	.73	.93
6452	1.61	1.23	.38	3.24	59	135	.43	3.47	.75	.82	1.12
Ionia County:											
6473	.85	.57	.28	2.04	71	59	1.20	1.88	.51	.52	.79
6477	1.22	.54	.68	.79	70	142	.49	2.05	.87	1.59	1.44
6475	.92	.57	.35	1.62	70	136	.51	2.69	.52	.61	.87
Kent County:											
6516	1.06	.54	.52	1.03	87	126	.69	3.55	1.06	1.15	1.29
6517	.92	.63	.29	2.17	92	95	.96	2.65	.82	.92	1.00
6515	.96	.57	.39	1.46	80	102	.78	2.87	.74	.90	1.02
6514	.82	.50	.32	1.56	71	69	1.03	2.47	.62	.78	.84
Lenawee County:											
6450	.99	.71	.28	2.55	77	81	.96	2.83	.73	.81	.95
6322	.83	.57	.26	2.19	66	74	.89	2.64	.86	.61	.87
Ottawa County:											
6491	.94	.58	.36	1.61	62	69	.89	1.90	.58	.91	.85
6490	1.04	.56	.48	1.16	68	110	.61	2.36	.83	.83	1.19
6513	1.08	.51	.56	.91	65	138	.47	3.33	.73	1.05	1.14
6512	.88	.57	.31	1.84	55	101	.54	2.54	.52	.96	.85
Average (23)	.99	.63	.36	1.75	71	99	.72	2.60	.68	.84	1.00
Maximum	1.61	1.23	.68	3.24	92	142	1.20	3.55	1.11	1.59	1.44
Minimum	.81	.50	.23	.79	55	59	.43	1.88	.30	.52	.79

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

NEW HAMPSHIRE.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Cheshire County:											
6658	0.93	0.54	0.39	1.41	74	118	0.63	3.00	0.58	0.98	1.06
6657	1.00	.58	.42	1.38	77	102	.75	3.02	.81	1.05	1.14
6659	1.11	.67	.44	1.52	84	111	.75	3.46	.97	1.13	1.27
Hillsboro County:											
6655	1.10	.81	.29	2.79	84	77	1.09	2.89	.76	.90	.99
6656	1.04	.70	.33	2.12	84	77	1.09	2.43	.72	.65	.83
Grafton County:											
6681	.79	.47	.32	1.47	62	93	.66	2.74	.51	.81	.84
6682	.94	.57	.37	1.54	59	84	.70	2.75	.42	.68	.78
6673	.79	.43	.36	1.19	73	83	.87	2.84	.61	.85	.91
6671	1.01	.57	.44	1.30	79	101	.78	2.76	.66	.86	1.01
6672	.93	.57	.36	1.58	71	90	.78	2.01	.69	.91	1.01
6683	.82	.43	.39	1.10	56	97	.58	1.88	.60	.72	.90
6670	.94	.57	.37	1.54	85	94	.90	2.88	.72	.94	1.07
Sullivan County:											
6630	.68	.42	.26	1.42	50	66	.75	2.22	.35	.63	.66
6675	.97	.41	.56	.73	74	130	.56	2.26	.63	.98	1.13
6674	1.03	.62	.41	1.51	76	118	.64	2.35	.74	.98	1.10
Average (15)	.94	.55	.39	1.41	72	96	.75	2.63	.65	.87	.98
Maximum	1.04	.81	.44	2.79	85	130	1.09	3.46	.97	1.13	1.27
Minimum	.68	.41	.26	.73	50	66	.56	1.88	.35	.63	.66

NEW YORK.

Allegany County:											
6525	0.86	0.57	0.29	1.96	71	97	0.73	2.40	0.91	0.88	1.00
6524	.86	.57	.29	1.96	71	86	.82	2.49	.85	.90	.93
6523	.89	.63	.25	2.52	75	74	1.01	2.20	.86	.87	.93
Cattaraugus County:											
6530	.84	.54	.29	1.86	83	93	.89	2.66	.77	.88	.97
6528	.82	.57	.25	2.28	72	62	1.16	1.88	.66	.74	.77
6527	.79	.55	.24	2.29	61	50	1.22	1.98	.46	.47	.65
6529	.89	.59	.30	1.96	74	89	.83	2.44	.83	.92	.98
6526	.82	.58	.24	2.41	66	50	1.32	2.11	.45	.57	.69
Chautauqua County:											
6537	.93	.46	.47	.98	57	102	.56	2.37	.81	.81	1.05
6538	.86	.51	.35	1.46	68	72	.94	1.92	.63	.65	.88
6535	1.05	.58	.47	1.23	73	93	.78	2.37	.71	.76	.97
6583	.98	.57	.41	1.39	83	87	.95	2.52	.82	.98	1.05
6585	1.12	.74	.38	1.95	64	80	.80	2.02	.59	.77	.89
6581	.86	.46	.40	1.15	61	83	.74	2.79	.63	.70	.86
6575	.95	.63	.31	2.03	69	95	.73	2.76	.73	.70	.93
6539	1.06	.62	.44	1.40	78	88	.88	2.51	.90	.78	1.03
6588	.81	.47	.34	1.39	66	75	.88	1.88	.59	.74	.83
6533	1.04	.68	.36	1.90	73	82	.90	2.82	.68	.69	.95
6592	1.03	.58	.45	1.30	70	102	.68	2.82	.76	.94	1.06
6589	.93	.51	.42	1.21	67	96	.69	2.40	.68	.87	.99
6536	.96	.61	.35	1.75	76	77	.98	2.34	.77	.83	.95
6587	.93	.54	.38	1.43	63	86	.73	2.74	.69	.79	.93
6591	.93	.57	.36	1.60	67	77	.87	2.67	.66	.83	.94
6576	.93	.67	.26	2.57	67	92	.73	2.76	.70	.72	.81
6578	.83	.50	.33	1.53	65	68	.95	2.64	.47	.74	.98
6404	.85	.52	.33	1.57	61	69	.88	2.00	.64	.56	.82
6582	.94	.51	.43	1.18	69	96	.71	2.36	.75	.90	1.00
6415	1.00	.71	.29	2.45	93	131	.71	2.28	.81	.87	1.15
6593	1.21	.83	.38	2.18	80	87	.91	2.46	.79	.72	1.01
6531	.82	.50	.32	1.56	68	95	.71	2.39	.88	.87	1.01
6584	.90	.60	.30	2.00	70	60	1.16	2.32	.57	.63	.80
6594	1.02	.66	.36	1.84	77	91	.85	2.46	.71	.80	.99
6579	.92	.62	.30	2.06	58	75	.77	2.33	.58	.69	.83
6532	.92	.56	.36	1.55	75	110	.68	2.78	1.03	1.07	1.18
6590	1.19	.74	.45	1.64	73	107	.68	2.56	.79	.99	1.07
6580	.89	.54	.35	1.55	62	66	.94	2.54	.57	.64	.85
6577	.80	.57	.23	2.50	67	71	.94	1.85	.50	.64	.73
6586	.91	.49	.42	1.16	67	91	.74	2.17	.66	.92	.85

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

NEW YORK—Continued.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Chenango County:											
6502	1.00	0.76	0.24	3.17	81	64	1.26	2.41	0.64	0.66	0.85
6503	.98	.67	.30	2.23	89	92	.96	3.01	.90	1.08	1.18
Cortland County:											
6501	.96	.66	.30	2.20	76	74	1.03	2.80	.71	.82	.97
6540	.77	.49	.28	1.75	54	72	.75	2.17	.54	.57	.77
6470	.97	.64	.33	1.94	63	99	.63	3.05	.59	.96	1.13
6471	1.04	.56	.48	1.16	69	99	.69	2.29	.86	.94	1.13
6543	.04	.68	.36	1.90	66	69	.95	2.07	.89	.65	.85
6544	.87	.55	.32	1.71	58	67	.86	1.88	.53	.59	.79
6464	.92	.61	.31	1.96	71	71	1.00	2.34	.59	.99	.85
6465	.92	.56	.36	1.56	53	92	.57	2.35	.98	.83	1.08
6478	.98	.75	.23	2.88	73	60	1.20	2.40	.53	.62	.82
6541	.94	.63	.31	2.03	80	70	1.14	2.30	.84	.74	.96
6542	1.12	.73	.39	1.86	83	80	1.03	2.52	.91	.84	1.04
Delaware County:											
6631	.96	.55	.41	1.34	71	99	.71	2.24	.69	1.40	1.74
6629	.94	.70	.24	2.91	72	85	.84	2.84	.66	.87	.97
6630	.91	.58	.33	1.76	72	90	.80	2.14	.72	.97	1.31
6628	.85	.62	.23	2.69	61	65	.93	2.34	.55	.55	.78
6627	1.13	.68	.45	1.51	82	98	.83	2.85	.90	1.08	1.16
Lewis County:											
6565	.85	.55	.30	1.84	58	85	.68	2.61	.56	.75	.89
6568	.78	.44	.34	1.29	55	85	.64	2.32	.69	.82	.88
6571	.88	.52	.36	1.44	61	107	.57	2.09	.54	.79	.87
6569	.89	.65	.24	2.70	67	78	.84	2.33	.49	.58	.80
6570	.82	.50	.32	1.56	66	88	.75	1.95	.51	.76	.79
6564	.86	.49	.37	1.32	58	90	.64	2.72	.67	.87	.94
6567	.80	.48	.32	1.50	64	77	.83	2.25	.85	.77	.85
6566	.84	.58	.26	2.23	67	68	.98	1.86	.48	.65	.68
Wyoming County:											
6521	.98	.70	.28	2.50	84	84	1.00	2.35	.93	.87	.98
6522	.89	.63	.26	2.40	68	65	1.04	2.17	.46	.52	.72
Average (66)	.93	.59	.34	1.73	69	83	.83	2.39	.70	.79	.94
Maximum	1.21	.83	.48	3.17	93	131	1.32	3.05	1.03	1.40	1.74
Minimum	.77	.44	.23	.98	53	50	.56	1.85	.45	.47	.65

OHIO.

Ashtabula County:											
6647	0.91	0.50	0.41	1.21	67	109	0.62	2.73	1.09	0.85	1.13
6440	.96	.47	.49	.97	62	144	.43	2.49	.82	.74	1.09
6973	.96	.72	.24	3.00	53	66	.80	2.58	.71	.87	.83
6441	.96	.56	.40	1.40	73	107	.68	2.50	.90	.71	.99
6442	.99	.55	.44	1.25	74	108	.68	2.48	.86	.71	1.03
6443	.93	.60	.33	1.81	65	99	.65	2.53	.90	.83	1.14
6992	.84	.57	.27	2.14	72	66	1.09	2.75	.81	.88	.96
Champaign County:											
6309	1.01	.63	.38	1.65	75	113	.67	2.86	.92	.46	.96
6391	1.06	.60	.46	1.30	81	92	.88	2.56	.71	.90	1.06
6392	1.17	.86	.31	2.77	86	93	.92	2.77	1.05	.77	1.05
6310	1.01	.77	.24	3.20	85	98	.87	2.91	1.14	.....	.....
6393	1.12	.76	.36	2.11	94	101	.93	2.65	.85	.70	1.06
6308	.89	.61	.28	2.18	68	85	.80	2.84	1.28	.44	.97
6400	1.08	.64	.44	1.45	81	95	.85	2.94	.91	.81	1.08
6401	1.61	.61	1.01	.60	82	163	.50	4.41	1.51	1.44	1.82
Cuyahoga County:											
6366	.89	.51	.38	1.34	54	96	.56	2.80	.86	.98	.77
6985	.94	.60	.34	1.76	74	82	.90	2.75	.81	.85	.96
6364	.90	.54	.36	1.50	56	78	.71	1.93	.56	.87	.92
6365	.93	.61	.32	1.90	65	105	.62	2.54	.76	.92	1.02
6986	1.00	.55	.45	1.23	65	104	.62	2.97	.77	.89	1.01
6363	.81	.57	.24	2.37	59	71	.83	2.42	.72	.81	.63
6975	.98	.72	.26	2.77	79	70	1.12	2.96	.86	.86	.99

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

OHIO—Continued.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Geauga County:											
6369	0.95	0.64	0.31	2.07	68	114	0.59	2.39	0.68	0.82	1.01
7018	1.28	.75	.53	1.42	82	124	.66	3.69	.82	1.09	1.24
6379	.82	.55	.27	2.04	41	47	.87	2.74	.56	.53	.68
6987	.92	.54	.38	1.42	62	92	.67	2.85	.73	1.01	1.03
6970	.92	.57	.35	1.63	66	85	.78	2.87	.80	.88	1.00
6977	1.03	.60	.43	1.39	68	117	.58	3.54	1.02	1.06	1.22
6375	.86	.62	.24	2.58	57	65	.88	1.86	.69	.52	.78
6380	.96	.59	.37	1.60	58	109	.53	2.67	.65	.53	.99
6981	1.21	.66	.55	1.20	63	124	.50	3.43	.89	1.03	1.19
6367	.99	.65	.34	1.91	61	118	.51	2.77	.79	.84	1.07
6991	1.00	.59	.41	1.43	65	106	.61	3.09	.91	.99	1.12
6372	.88	.58	.30	1.93	64	92	.69	2.20	.61	.67	.91
6982	1.24	.83	.41	2.02	75	114	.65	3.54	.86	1.04	1.21
6381	.82	.57	.25	2.28	64	96	.66	2.29	.63	.64	.91
6376	.90	.60	.30	2.00	67	99	.68	2.47	.77	.84	1.01
6368	.90	.62	.28	2.21	68	100	.68	2.56	.66	.62	1.03
6371	.80	.45	.35	1.28	59	100	.59	2.50	.66	.77	.97
6377	1.05	.69	.36	1.92	68	128	.53	2.78	.84	.91	1.17
6978	1.02	.65	.37	1.76	73	100	.73	3.01	.83	.92	1.05
Logan County:											
6273	1.08	.68	.40	1.70	65	102	.64	2.44	.87	1.00	1.15
6265	1.23	.82	.41	2.00	107	117	.91	3.37	1.11	1.08	1.33
6285	.94	.61	.33	1.85	63	117	.53	2.78	1.12	.81	1.06
6305	1.07	.67	.40	1.68	91	121	.75	2.99	1.03	1.16	1.13
6306	1.14	.67	.47	1.40	86	131	.65	3.11	1.04	1.14	1.07
6293	1.22	.56	.66	.85	65	166	.40	3.52	1.30	1.34	1.58
6271	1.17	.81	.36	2.25	99	93	1.06	3.09	1.19	.95	1.34
6290	1.10	.68	.42	1.62	91	115	.79	3.11	1.09	1.09	1.27
6281	.92	.61	.31	1.97	68	108	.63	2.65	1.02	.79	1.04
6298	1.53	1.04	.49	2.12	98	141	.70	3.72	1.15	1.22	1.50
6275	1.33	.86	.47	1.83	102	126	.80	3.59	1.29	1.20	1.49
6297	1.06	.54	.52	1.04	66	135	.48	2.79	.96	1.02	1.24
6292	1.35	.72	.63	1.13	91	158	.57	3.45	1.09	1.30	1.42
6296	1.00	.57	.43	1.32	73	121	.60	2.56	.94	1.03	1.17
6291	1.00	.76	.24	3.16	87	96	.90	3.00	1.02	.93	1.16
6302	1.15	.66	.49	1.36	88	142	.62	3.20	1.17	1.15	1.20
6300	1.36	.71	.65	1.09	90	174	.52	3.71	1.27	1.46	1.66
6301	1.45	.71	.74	.96	92	166	.55	4.24	1.37	1.60	1.74
6294	1.01	.63	.38	1.66	82	118	.70	2.67	1.03	1.00	1.16
6295	1.03	.66	.37	1.77	67	128	.52	2.87	1.15	.83	1.13
6307	1.15	.72	.43	1.67	96	125	.76	2.83	.90	1.09	1.15
6299	1.27	.72	.56	1.28	96	141	.68	3.46	1.28	1.28	1.50
6286	.99	.69	.30	2.30	90	84	1.07	3.70	1.23	1.05	1.34
6262	1.14	.68	.46	1.48	91	139	.65	3.28	1.33	1.01	1.03
6263	1.12	.66	.46	1.43	97	119	.81	3.05	1.27	.97	1.13
6274	1.01	.71	.30	2.37	93	84	1.10	2.74	1.01	1.04	1.14
6304	1.17	.67	.50	1.34	87	146	.59	3.17	1.14	1.13	1.11
6284	1.19	.71	.48	1.48	99	118	.84	3.75	1.27	1.18	1.52
6267	1.05	.76	.29	2.62	104	84	1.24	2.94	1.07	.98	1.26
6288	1.13	.81	.32	2.53	112	90	1.24	3.47	1.10	1.04	1.33
6264	1.11	.73	.38	1.92	100	112	.89	3.22	1.46	1.00	1.23
6282	1.04	.75	.29	2.60	82	100	.82	3.00	1.39	.94	1.17
6283	1.04	.75	.29	2.60	85	107	.79	2.96	1.26	.91	1.21
6280	1.19	.83	.36	2.30	116	90	1.28	3.21	1.21	1.04	1.34
6277	1.12	.76	.36	2.11	106	94	1.12	3.26	1.07	1.07	1.30
6303	1.22	.69	.53	1.30	88	142	.61	3.31	1.10	1.19	1.20
6268	.91	.58	.33	1.76	63	104	.61	2.45	.84	.64	.85
6276	1.30	.89	.41	2.17	104	104	1.00	3.87	1.18	1.07	1.38
6269	1.19	.86	.33	2.60	122	93	1.31	3.63	1.21	1.08	1.37
6278	1.42	.85	.57	1.49	111	132	.84	4.01	1.45	1.24	1.57
6287	1.04	.76	.28	2.72	82	107	.76	2.90	1.21	.83	1.13
6266	1.38	.84	.54	.56	115	130	.89	3.61	1.29	1.17	1.48
6279	.99	.74	.25	2.96	98	69	1.42	2.98	1.05	1.05	1.25
6289	1.38	.67	.71	.94	90	174	.51	3.90	1.28	1.41	1.64
6270	1.31	.78	.53	1.47	111	131	.85	3.75	1.17	1.16	1.48
6272	1.15	.82	.33	2.48	108	101	1.07	3.35	1.26	1.23	1.40

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

OHIO—Continued.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A.O.A.C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Mahoning County:											
6650	0.92	0.54	0.38	1.42	71	105	0.67	2.91	0.57	0.91	1.01
6651	1.23	.84	.39	2.15	91	101	.91	3.71	.89	1.00	1.03
6988	1.29	.88	.41	2.14	94	109	.86	3.51	.75	.92	1.14
6652	1.05	.58	.47	1.24	66	128	.51	3.18	.58	.98	1.08
6984	1.14	.67	.47	1.42	65	120	.54	3.86	.88	.90	1.25
Medina County:											
6974	1.04	.65	.39	1.66	75	101	.74	3.19	.79	.92	1.04
6360	.93	.54	.29	1.86	64	64	1.00	2.45	.65	.80	.67
6976	1.03	.69	.34	2.02	83	90	.92	3.06	.65	.77	.88
6256	.90	.66	.24	2.75	84	66	1.27	2.28	.90	.60	.82
6257	.86	.62	.24	2.58	80	62	1.28	2.31	1.02	.65	.89
6971	1.17	.90	.27	3.33	99	102	.97	3.12	.88	.84	.97
6689	.97	.54	.43	1.25	80	100	.80	2.24	.82	.93	1.10
6690	.88	.50	.38	1.32	73	98	.75	2.11	.85	.88	1.04
6691	1.20	.66	.54	1.22	85	125	.68	2.67	.89	1.06	1.14
6254	.88	.55	.33	1.67	77	93	.83	2.71	1.08	.80	1.30
6255	.98	.58	.39	1.48	79	101	.78	2.99	1.18	.92	1.10
6989	1.21	.84	.36	2.34	94	61	1.55	3.73	1.07	1.07	1.22
6252	.79	.52	.27	1.93	81	67	1.20	2.45	.79	.43	.78
6253	.78	.55	.23	2.39	78	81	.96	2.42	.86	.62	.86
6980	1.18	.90	.28	3.21	87	87	1.00	3.63	.97	.95	1.11
Morrow County:											
6347	1.17	.78	.39	2.00	95	133	.71	3.32	.98	.86	1.12
6337	.85	.58	.27	2.15	73	76	.96	2.24	.79	.29	.71
6357	1.25	.89	.36	2.47	102	93	1.09	3.75	.95	1.07	1.03
6355	1.00	.66	.34	1.94	80	71	1.13	2.22	.83	.74	.83
6332	1.01	.61	.40	1.52	67	118	.57	2.77	1.16	.69	1.09
6333	1.22	.80	.42	1.90	89	127	.70	3.23	1.29	.74	1.25
6334	.91	.66	.25	2.64	75	72	1.04	2.99	.81	.86	.91
6352	1.08	.70	.38	1.84	77	74	1.04	2.98	.82	1.00	1.03
6353	1.12	.74	.38	1.95	81	77	1.06	2.37	.88	1.03	1.02
6354	1.18	.69	.49	1.40	77	98	.78	2.71	.94	1.20	1.18
6331	1.03	.68	.35	1.94	81	107	.75	2.69	1.03	.64	1.01
6344	1.07	.73	.34	2.14	101	101	1.00	3.17	1.09	.79	1.07
6349	1.05	.70	.35	2.00	94	100	.94	3.13	1.12	.91	1.13
6336	1.39	.88	.51	1.73	79	159	.43	3.55	1.63	.94	1.13
6335	1.22	.80	.42	1.91	81	138	.58	3.19	1.32	.67	1.34
6330	.99	.63	.36	1.75	73	120	.60	2.73	1.19	.57	1.01
6350	1.12	.74	.38	1.96	82	115	.71	3.74	1.14	1.29	.95
6351	.88	.64	.24	2.66	96	63	1.52	2.37	.92	.92	.81
6343	1.01	.73	.28	2.60	101	91	1.11	2.82	1.01	.83	1.10
6340	1.16	.75	.41	1.82	106	119	.88	3.37	1.19	1.15	1.21
6341	1.09	.60	.49	1.22	97	119	.81	3.04	1.07	1.03	.94
6336	1.39	.88	.51	1.73	79	159	.50	3.55	1.63	.94	1.13
6348	1.09	.84	.25	3.36	95	76	1.25	3.30	.86	.97	1.02
6338	1.03	.68	.35	1.95	109	98	1.11	2.95	1.03	.98	1.20
6356	.91	.65	.26	2.50	72	72	1.00	3.19	.98	.95	.69
6342	1.19	.62	.57	1.08	91	147	.62	3.63	1.22	1.04	1.19
6345	.97	.64	.33	1.94	94	92	1.02	2.85	.97	.66	.92
Portage County:											
6361	.94	.62	.32	1.94	68	80	.85	1.99	.72	.85	.90
6983	.77	.53	.24	2.20	58	64	.90	2.64	.67	.78	.82
6362	1.01	.55	.46	1.20	58	95	.61	2.50	.87	.99	1.02
Trumbull County:											
6648	.90	.56	.34	1.64	72	91	.79	2.48	1.00	.71	1.02
6649	1.10	.56	.54	1.03	81	121	.67	3.25	1.30	.94	1.27
6979	1.14	.90	.24	3.75	85	85	1.00	3.10	.79	.78	1.03
Union County:											
6311	.98	.63	.35	1.80	70	104	.67	2.77	.98	.70	1.03
Average (141)	1.07	.68	.39	1.75	81	106	.76	2.99	.99	.92	1.12
Maximum	1.61	1.04	1.01	3.75	122	174	1.53	4.41	1.65	1.60	1.82
Minimum	.77	.45	.23	.60	41	47	.40	1.86	.56	.29	.63

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

PENNSYLVANIA.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Bradford County:											
6846	0.82	0.58	0.24	2.42	79	69	1.13	2.57	0.81	0.71	0.90
6857	.93	.64	.29	2.20	77	115	.66	3.19	1.07	.89	1.07
6845	.92	.56	.36	1.56	78	89	.87	2.67	.86	.83	.95
6856	1.02	.65	.37	1.76	84	102	.82	2.61	.92	1.02	1.07
6854	1.10	.78	.32	2.45	76	86	.88	3.17	.97	.91	1.09
6855	1.16	.78	.38	2.05	95	98	.97	2.90	.82	.82	.97
6853	1.05	.76	.29	2.63	73	82	.88	2.83	.80	.86	.93
Fayette County:											
6852	1.05	.75	.30	2.50	94	91	1.03	2.66	.91	.91	.99
6848	1.02	.75	.27	2.77	76	70	1.09	2.74	.97	.94	.98
6849	1.14	.88	.25	3.52	51	77	.66	3.03	.94	.91	1.01
6847	.97	.68	.29	2 34	84	77	1.09	2.72	.96	.93	.97
6851	.93	.70	.23	3.04	92	78	1.18	2.57	1.21	.87	.94
6850	1.24	.86	.38	2.26	79	95	.83	3.70	1.04	1.02	1.18
Lancaster County:											
6836	1.10	.78	.32	2.44	91	85	1.07	3.54	.96	1.07	1.07
Somerset County:											
6863	1.07	.77	.30	2.57	77	70	1.10	3.23	1.14	.98	1.10
6859	1.14	.86	.28	3.07	81	69	1.18	3.20	.92	.86	.81
6838	1.16	.90	.26	3.46	88	69	1.27	3.51	1.01	1.09	1.08
6842	1.36	1.08	.28	3.86	120	82	1.46	4.28	1.30	1.17	1.19
6843	1.08	.71	.37	1.92	84	93	.90	3.00	.89	.92	1.05
6860	1.13	.84	.29	2.89	79	67	1.18	3.15	.92	.87	.96
6861	1.33	.96	.37	2.59	94	97	.96	3.68	1.11	1.08	1.22
6885	1.06	.68	.38	1.80	76	85	.89	2.71	.82	.95	1.01
6839	.98	.71	.27	2.63	84	74	1.13	3.08	.95	1.06	1.01
6862	1.14	.66	.48	1.40	86	111	.77	2.99	.96	1.10	1.17
6844	.99	.66	.32	2.06	87	71	1.23	2.78	.93	.77	.92
6841	.99	.71	.28	2.54	81	75	1.08	3.28	.86	1.03	.98
6840	1.04	.70	.34	2.06	90	80	1.18	3.54	1.08	.87	1.10
6837	1.14	.74	.40	1.85	95	104	.91	3.32	1.14	1.10	1.15
Warren County:											
6402	.80	.46	.34	1.35	61	81	.75	1.87	.58	.59	.80
6423	.83	.59	.24	2.45	86	125	.69	2.03	.67	.77	1.04
6407	.89	.63	.26	2.42	63	63	1.00	1.86	.69	.62	.80
6411	.95	.64	.31	2.06	101	140	.72	2.48	.83	.89	1.13
6417	.87	.58	.29	2.00	62	68	.91	2.95	.63	.53	.73
6418	.95	.66	.29	2.28	89	130	.68	2.49	.84	.91	1.03
6409	.84	.51	.33	1.54	61	71	.86	2.17	.69	.67	.86
6427	1.07	.67	.40	1.68	71	77	.92	2.74	.70	.98	.97
6419	.93	.64	.29	2.20	76	70	1.08	2.46	.60	.86	.83
6410	.96	.66	.30	2.20	98	136	.72	2.47	.86	.84	1.15
6422	.89	.63	.26	2.42	86	128	.67	2.34	.77	.83	1.16
6416	1.06	.65	.41	1.58	61	151	.40	2.82	.94	1.05	1.29
6408	.93	.63	.30	2.10	69	77	.90	2.09	.86	.89	.99
6414	1.24	.61	.63	.96	79	135	.58	1.94	.59	.75	1.03
6412	.91	.61	.30	2.03	70	76	.92	1.86	.67	.63	.91
6424	1.04	.78	.26	3.00	104	130	.80	2.47	.88	.91	1.16
6426	.90	.51	.39	1.30	58	137	.42	2.06	.55	.60	.83
6403	.94	.70	.24	2.92	74	65	1.13	2.02	.82	.70	.91
6425	.91	.49	.42	1.16	73	88	.83	2.04	.67	.63	.91
6428	.92	.68	.24	2.83	71	72	.98	2.44	.61	.78	.85
6405	.92	.65	.27	2.40	48	67	.71	3.09	.59	.59	.78
6413	1.19	.85	.34	2.50	96	142	.68	2.64	.90	.90	1.18
6406	.97	.62	.35	1.77	70	70	1.00	2.24	.72	.64	.91
6420	.90	.60	.30	2.00	90	135	.66	2.40	.85	.93	1.15
6421	1.00	.61	.39	1.56	94	162	.58	2.59	.58	.79	1.13
6429	.93	.56	.37	1.51	70	95	.73	2.30	.83	.75	1.10
6858	.80	.52	.28	1.85	56	81	.69	2.80	.88	.96	.99
Average (55)	1.01	.68	.33	2.06	80	93	.86	2.73	.86	.87	1.01
Maximum	1.36	1.08	.63	3.86	120	162	1.46	4.28	1.30	1.10	1.29
Minimum	.80	.46	.23	.96	48	63	.40	1.86	.55	.53	.73

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

VERMONT.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Addison County:											
6706	0.82	0.57	0.25	2.28	95	75	1.26	2.18	0.31	0.68	0.77
6705	.88	.62	.26	2.38	60	57	1.05	2.58	.43	.53	.65
Bennington County:											
6609	1.01	.71	.30	2.37	78	87	.90	2.13	.62	.74	.92
Chittenden County:											
6707	.80	.51	.29	1.76	68	71	.95	1.86	.52	.64	.76
6708	1.09	.57	.52	1.08	83	103	.80	2.67	.75	.86	1.08
6709	.97	.35	.62	.57	60	110	.54	2.44	.73	.82	1.04
Franklin County:											
6725	.81	.50	.31	1.61	64	59	1.08	2.54	.46	.57	.71
6726	1.30	.75	.55	1.36	94	114	.82	2.85	.91	.96	1.26
6722	.91	.59	.32	1.83	66	62	1.06	3.12	.47	.68	.74
6721	.77	.54	.23	1.91	56	71	.78	2.13	.32	.71	.65
6723	.86	.60	.26	2.30	64	52	1.23	1.92	.60	.57	.74
6724	.91	.68	.23	2.95	79	59	1.35	2.00	.63	.75	.81
6720	.83	.44	.39	1.12	75	86	.86	2.14	.55	.58	.86
Lamoille County:											
6738	.87	.48	.39	1.23	57	84	.68	2.09	.31	.65	.83
6736	.81	.57	.24	2.37	57	65	.87	3.51	.32	.48	.68
6739	1.05	.80	.25	3.20	77	74	1.04	2.22	.64	.67	.93
6733	1.15	.88	.27	3.25	65	125	.52	2.43	.59	.72	1.08
6732	1.00	.77	.23	3.35	63	119	.53	2.26	.45	.80	.98
6741	.85	.61	.24	2.55	64	61	1.04	1.89	.42	.66	.80
6728	.81	.48	.33	1.45	57	90	.63	2.53	.66	.71	.83
6768	.78	.53	.24	2.20	58	67	.87	1.85	.42	.81	.80
6769	.97	.43	.54	.79	55	117	.47	3.01	.63	.89	1.07
6734	.96	.70	.26	2.70	57	101	.56	2.19	.57	.70	.91
6771	.85	.46	.39	1.18	49	73	.67	3.21	.35	.61	.77
6730	.80	.40	.40	1.00	46	83	.55	3.18	.40	.66	.75
6740	.80	.52	.28	1.86	47	75	.62	2.80	.26	.66	.74
6770	.96	.52	.44	1.18	60	109	.55	2.40	.46	.75	.99
6731	.86	.49	.37	1.32	62	84	.74	2.00	.48	.79	.89
6727	1.06	.71	.35	2.03	58	125	.46	2.38	.53	.90	1.03
6737	.82	.47	.35	1.34	50	85	.59	2.04	.43	.73	.85
6729	.79	.52	.27	1.93	57	71	.80	2.10	.47	.63	.77
6735	1.00	.76	.24	3.16	52	113	.46	2.49	.61	.82	1.01
6742	.91	.62	.29	2.14	69	73	.93	2.07	.54	.72	.87
Orleans County:											
6780	.86	.50	.36	1.39	64	91	.70	2.29	.54	.83	.89
6772	.90	.67	.23	2.91	73	55	1.32	2.09	.57	.57	.79
6777	.86	.57	.29	1.97	68	55	1.23	2.89	.41	.56	.71
6778	1.31	.65	.66	.98	74	182	.40	2.90	.61	1.11	1.44
6782	.84	.54	.30	1.80	63	66	.95	2.93	.34	.57	.68
6776	1.04	.58	.46	1.26	72	129	.56	2.93	.75	1.09	1.25
6781	.84	.46	.38	1.21	59	84	.70	2.04	.40	.64	.73
6773	.77	.51	.26	1.96	68	45	1.51	2.63	.32	.41	.58
6774	.87	.58	.29	2.00	76	82	.92	2.28	.52	.69	.87
6775	.97	.73	.24	3.04	80	46	1.73	2.24	.55	.49	.69
6779	.92	.57	.35	1.62	60	106	.60	2.33	.55	.74	.95
Rutland County:											
6635	.91	.64	.27	2.37	80	75	1.06	1.85	.51	1.09	1.68
6634	.92	.56	.36	1.60	73	104	.70	2.12	.66	1.26	1.64
6633	.91	.57	.34	1.67	71	90	.78	2.00	.65	1.13	1.47
Windham County:											
6612	1.35	.79	.56	1.42	75	154	.48	3.16	1.13	1.25	1.44
6610	.93	.65	.28	2.32	63	80	.78	2.14	.75	.81	.95
6611	1.07	.64	.43	1.48	64	119	.54	2.63	.86	.98	1.15
Average (50)	.93	.59	.34	1.74	66	87	.76	2.41	.54	.75	.93
Maximum	1.35	.88	.66	3.35	95	154	1.73	3.51	1.13	1.26	1.68
Minimum	.77	.35	.23	.57	46	45	.40	1.86	.26	.41	.58

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

WEST VIRGINIA.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
	Per cent.	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
Greenbrier County:											
6653	1.10	0.81	0.29	2.79	102	92	1.10	3.61	1.09	1.09	1.22
6990	1.29	.95	.34	2.79	99	87	1.14	3.65	1.23	.90	1.29
Upshire County:											
6654	1.32	.74	.58	1.28	103	146	.70	4.20	1.20	1.29	1.49
Average (3)	1.24	.83	.41	2.02	101	108	.93	3.82	1.17	1.09	1.33
Maximum	1.32	.95	.58	2.79	103	146	1.14	4.20	1.23	1.29	1.49
Minimum	1.10	.74	.29	1.28	99	87	.70	3.61	1.09	.90	1.22

UNITED STATES.

Average (395)	1.02	0.64	0.38	1.68	76	97	0.78	2.72	0.82	0.85	1.04
Maximum	1.68	1.23	1.01	3.86	122	208	1.83	4.41	1.65	1.60	1.82
Minimum	.68	.35	.23	.57	41	41	.21	1.76	.20	.29	.31

CANADA.

Province of Quebec:											
6822	1.09	0.61	0.48	1.28	66	123	0.53	2.42	0.63	0.92	1.15
6917	.95	.56	.39	1.43	74	86	.86	2.79	.54	.77	.84
6804	.82	.44	.38	1.16	66	63	1.05	2.41	.61	.77	.99
6899	.80	.44	.36	1.22	45	91	.50	1.89	.29	.71	.82
6928	1.13	.70	.43	1.63	88	110	.80	3.24	.64	.76	.93
6925	1.05	.50	.55	.90	70	116	.60	2.90	.55	.87	.88
6918	.89	.63	.26	2.42	69	86	.80	1.86	.34	.50	.54
6911	.91	.65	.26	2.50	80	68	1.18	2.37	.52	.68	.71
6831	.78	.47	.31	1.51	75	52	1.44	2.05	.26	.58	.84
6919	.92	.59	.33	1.79	78	87	.89	2.48	.33	.69	.69
6930	.84	.41	.43	.95	62	95	.65	2.78	.69	.79	.84
6914	.92	.64	.28	2.28	83	68	.21	2.40	.50	.67	.70
6913	.92	.63	.29	2.17	71	77	.92	2.42	.52	.70	.71
6904	1.03	.36	.67	.53	50	.....	.....	3.17	.53	1.05	1.20
6934	.80	.37	.43	.86	48	73	.66	2.08	.59	.73	.79
6903	.96	.66	.30	2.20	74	85	.86	2.57	.60	.75	.91
6933	.95	.68	.27	2.52	61	83	.74	2.24	.59	.75	.81
6886	.88	.50	.38	1.32	64	84	.76	2.26	.49	.73	.74
6909	.83	.47	.36	1.60	53	116	.46	2.16	.32	.58	.64
6820	.94	.57	.37	1.54	58	109	.53	2.19	.72	.88	1.08
6907	.91	.52	.39	1.33	64	118	.54	2.97	.58	.86	.99
6908	1.14	.59	.55	1.08	74	131	.56	3.43	.60	.96	1.15
6902	1.06	.54	.52	1.04	60	115	.52	3.16	.65	1.09	1.13
6827	.77	.54	.23	2.39	61	61	1.00	1.85	.25	.55	.72
6818	.92	.60	.32	1.87	75	86	.86	2.19	.64	.81	.95
6890	.94	.53	.41	1.30	71	104	.68	2.09	.52	.86	.95
6900	1.13	.66	.47	1.40	75	127	.59	2.80	.20	.79	.94
6828	1.06	.56	.50	1.12	77	110	.70	2.71	.51	.88	1.12
6910	.85	.61	.24	2.54	74	68	1.08	2.39	.50	.64	.68
6887	1.03	.66	.37	1.87	70	86	.80	2.67	.56	.88	.88
6892	1.16	.84	.32	2.62	80	83	.96	2.67	.57	.76	.85
6893	.98	.69	.29	2.38	64	100	.64	2.59	.56	.81	.86
6816	1.08	.58	.50	1.16	73	134	.54	2.70	.73	.94	1.05
6901	1.02	.62	.40	1.55	67	86	.77	2.70	.54	.75	.87
6895	.92	.57	35	1.63	69	93	.74	2.14	.38	.87	.89
6823	.84	.54	.30	1.80	76	63	1.21	2.12	.41	.78	.88
6888	.79	.45	.34	1.32	60	90	.66	1.99	.43	.72	.78
6889	.97	.53	.44	1.20	68	139	.49	2.33	.44	.91	1.00
6922	1.01	.54	.47	1.15	73	112	.65	2.66	.57	.78	.86
6932	.78	.54	.24	2.25	66	73	.90	2.43	.57	.73	.82
6832	.83	.39	.44	.89	72	100	.72	2.03	.36	.77	.94
6935	.80	.49	.31	1.58	53	71	.75	2.39	.64	.70	.82
6808	.92	.46	.46	1.00	59	118	.50	2.60	.54	.92	1.08
6835	.80	.47	.33	1.42	64	83	.77	2.21	.53	.74	.77
6815	.89	.48	.41	1.17	69	107	.64	2.16	.55	.80	1.02

Ash data, lead number, and malic-acid value—Continued.

[Calculated to a moisture-free basis.]

CANADA—Continued.

Serial number and county.	Total ash.	Soluble ash.	Insoluble ash.	Sol. ash. / Insol. ash.	Alkalinity. Soluble ash.	Alkalinity. Insoluble ash.	Alk. sol. / Alk. insol.	Lead number. Basic.	Lead number. Neutral.	Malic-acid value. A. O. A. C. method.	Malic-acid value. Cowles method.
Province of Quebec—Continued.	*Per cent.*	*Per cent.*	*Per cent.*		*cc.*	*cc.*					
6926	.87	.52	.35	1.49	64	73	.88	1.98	.27	.51	.52
6807	.97	.61	.36	1.70	63	102	.61	2.37	.51	.79	.99
6931	.95	.65	.30	2.16	72	86	.83	2.79	.70	.70	.86
6921	.78	.41	.37	1.10	61	102	.60	2.38	.51	.71	.83
6912	.99	.62	.37	1.67	66	89	.74	2.82	.69	.84	.94
6824	1.16	.59	.57	1.03	91	121	.59	2.89	.58	1.03	1.22
6923	1.13	.51	.62	.82	77	124	.62	3.89	.79	1.02	1.14
6894	.91	.42	.49	.85	58	129	.44	2.31	.46	.98	1.00
6806	.85	.52	.33	1.57	73	80	.90	2.20	.55	.72	.89
6825	1.02	.60	.42	1.42	86	94	.91	2.88	.72	.89	1.09
6819	.95	.71	.24	2.96	71	77	.92	1.96	.62	.71	.87
6937	.88	.58	.30	1.93	69	83	.82	3.34	.97	.91	.95
6803	.99	.61	.38	1.60	70	103	.68	2.48	.54	.81	.99
6805	.80	.37	.43	.86	55	103	.52	2.77	.33	.57	.74
6916	.84	.55	.28	1.96	75	72	1.04	2.17	.42	.63	.69
6810	1.27	.73	.54	1.35	81	137	.59	3.20	.84	1.09	1.34
6924	1.14	.42	.72	.58	60	144	.42	3.92	.83	1.22	1.19
6812	.99	.55	.44	1.25	79	116	.68	2.55	.56	.81	1.05
6833	1.00	.50	.50	1.00	69	124	.55	2.91	.70	1.01	1.11
6811	.88	.52	.36	1.44	74	90	.82	2.61	.69	.83	1.01
6829	1.16	.59	.57	1.03	88	127	.68	2.82	.50	.85	1.23
6801	.86	.61	.25	2.44	73	86	.84	2.03	.49	.71	.91
6891	.83	.48	.35	1.37	61	91	.67	1.85	.44	.79	.80
6927	1.05	.73	.32	2.28	73	57	1.28	2.24	.52	.60	.62
6929	.92	.52	.40	1.30	71	89	.80	2.74	.55	.70	.73
6906	1.12	.60	.52	1.15	56	140	.40	3.26	.60	1.09	1.25
6834	1.20	.61	.59	1.03	83	134	.62	3.12	.90	1.14	1.22
6897	1.11	.60	.51	1.18	64	139	.46	3.48	.85	.94	1.28
6898	.93	.56	.37	1.51	61	94	.64	2.46	.55	.81	.91
6896	1.01	.58	.43	1.35	76	96	.78	2.22	.60	.93	.93
6905	.87	.58	.29	2.00	62	68	.90	2.19	.39	.67	.76
6920	.80	.55	.25	2.20	66	66	1.00	2.03	.53	.56	.74
6826	1.07	.53	.54	.98	78	118	.66	3.00	.60	.89	1.19
6830	.92	.54	.38	1.42	79	85	.92	2.31	.51	.85	.98
6813	.78	.43	.35	1.23	52	82	.62	3.20	.41	.64	.82
6809	.83	.55	.29	1.90	82	105	.78	2.17	.48	.60	.80
6817	.91	.60	.31	1.93	75	91	.82	2.15	.56	.79	.79
6814	.83	.42	.41	1.02	52	83	.62	3.17	.41	.52	.79
6802	.91	.40	.51	.78	63	128	.49	2.66	.64	.88	1.14
6821	1.35	.82	.53	1.54	66	114	.57	2.68	.63	.88	1.09
6915	.84	.61	.23	2.65	61	58	1.04	2.65	.13	.35	.21
Average (86)	.95	.56	.39	1.45	69	96	.72	2.55	.54	.79	.91
Maximum	1.35	.84	.72	2.96	88	144	1.44	3.92	.97	1.22	1.34
Minimum	.77	.36	.23	.53	45	52	.40	1.85	.13	.35	.21

UNITED STATES AND CANADA.

Average (481)	1.00	0.63	0.37	1.70	75	97	0.77	2.70	0.79	0.84	1.01
Maximum	1.68	1.23	1.01	3.86	122	208	1.83	4.41	1.65	1.60	1.82
Minimum	.68	.35	.23	.53	41	41	.21	1.76	.13	.29	.21

TOTAL ASH.

The figures for ash after calculation to a dry basis show an average for the United States samples of 1.02 with extremes of 1.68 and 0.68 per cent. On the whole number of samples, the average is 1 per cent and the extremes remain unchanged. Grouping the figures for ash by States and by 0.05 and 0.1 per cent differences the following results are obtained:

Total ash content of sirups (dry basis), grouped by States.

Ash content.	Number of samples.											Total.	
	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	Canada.	Number of samples.	Percentage of samples.
Per cent.													
0.00 to 0.76	.....	.....	.....	.....	[a]1	.....	.....	.....	.....	.....	.....	1	0.2
.77 to .79	.....	.....	.....	.....	2	3	3	.....	4	.....	6	18	3.7
.80 to .84	.....	.....	2	4	1	10	5	5	11	.....	16	54	11.2
.85 to .89	2	.....	2	3	.....	15	9	3	9	.....	10	53	11.0
.90 to .94	1	2	2	4	4	15	19	13	9	.....	16	85	17.7
.95 to .99	3	2	2	4	1	9	15	8	5	.....	11	60	12.4
1.00 to 1.09	7	1	.....	5	4	9	35	12	8	.....	14	95	19.8
1.10 to 1.19	1	.....	1	1	2	4	28	10	1	1	10	59	12.3
1.20 to 1.29	4	3	1	1	.....	1	14	2	.....	1	2	29	6.0
1.30 to 1.39	1	1	.....	.....	.....	.....	9	2	3	1	1	18	3.7
1.40 to 1.49	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	2	.4
1.50 to 1.59	2	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	3	.6
1.60 to 1.70	2	.....	.....	1	.....	.....	1	.....	.....	.....	.....	4	1.0
Total	23	9	10	23	15	66	141	55	50	3	86	481	100.0

[a] 0.68 per cent ash.

In Indiana about 30 per cent of the 23 samples collected had between 1 and 1.09 per cent of ash, the next largest class being 17 per cent with between 1.2 and 1.29 per cent of ash. One-third of the 9 Maine samples also fell in the latter class. In the case of Massachusetts 80 per cent of the samples were equally divided between the four classes between 0.80 and 0.99 per cent, the remaining samples being equally divided between the two classes ranging from 1.1 to 1.29. Of the 23 Michigan samples nearly 22 per cent had from 1 to 1.09 per cent of ash and 17 per cent were found in each of the following classes: 0.80 to 0.84, 0.90 to 0.94, and 0.95 to 0.99. Fifteen New Hampshire samples were examined, of which about 27 per cent had from 0.90 to 0.94 and an equal number from 1 per cent to 1.09. The comparison of the samples from New York, Ohio, Pennsylvania, Canada, and Vermont is of still more interest, as these represent the regions producing the largest amounts of sirup and more samples were taken. Of the 66 New York samples 45 per cent were equally divided between the two classes between 0.85 and 0.94 and an additional 27 per cent of the number are equally divided between 0.95 to 0.99 and 1 to 1.09 per cent ash content.

There were 141 samples of Ohio sirup collected and of these 25 per cent had from 1 to 1.09 per cent of ash, 20 per cent from 1.10 to 1.19, and 13.5 per cent had from 0.90 to 0.94 per cent of ash. The ash content was very high in these samples, both considering the individual samples and the averages, two samples falling in the maximum classes ranging from 1.5 to 1.7, Michigan and Indiana, especially the latter, being the only other States of which this is true. Of the Pennsylvania samples nearly one-fourth contained from 0.90 to 0.94 per cent of ash, and almost an equal number contained from 1 to 1.09 per cent; 18 per cent had from 1.10 to 1.19 per cent of ash, and 14.5 per cent from 0.95 to 0.99. Twenty-two per cent of the 50 Vermont samples had between 0.80 and 0.84 per cent of ash, while 36 per cent were equally divided between the next two classes ranging from 0.85 to 0.94. Sixteen per cent contained from 1 to 1.09 per cent of ash and 10 per cent from 0.95 to 0.99. The Canada samples showed very much the same distribution as those from Vermont. Of the 86 samples about 37 per cent were divided between two classes—i. e., 0.80 to 0.84 and 0.90 to 0.94, about 12 per cent falling in the intermediate grade and 13 per cent in the succeeding one. Sixteen per cent of the Canada samples contained from 1 to 1.09 per cent of ash, exactly the same proportion as in the case of Vermont, and about 12 per cent contained from 1.10 to 1.19. The three West Virginia samples were high in ash, ranging from 1.10 to 1.39. Considering the total number of 481 samples, it is seen that about one-fifth of them contain from 1 to 1.09 per cent of ash, this constituting the largest class, though almost 18 per cent contain from 0.90 to 0.94; 12 per cent are found in each of the two classes ranging from 0.95 to 0.99 and from 1.10 to 1.19, and 22 per cent are equally divided between the two classes ranging from 0.80 to 0.89.

If it be required that a maple sirup contain not more than 35 per cent of water and not less than 0.50 per cent of ash, figured to the dry basis, the minimum per cent of ash is 0.77. With the exception of the one sample from New Hampshire, which had 0.68 per cent of ash, the lowest per cent found reaches this figure, namely, 0.77, and only 18 out of 481 samples fall in the class ranging from 0.77 to 0.79 per cent. Granting that a standard commercial sirup weighs 11 pounds to a gallon, Jones's statement[a] that the total ash is never less than 0.50 per cent seems to be borne out in this investigation. The ash figured to dry substance under such a condition would be 0.77 per cent. Out of the 481 samples analyzed only 1 is below this figure and but 18 samples, or 3.7 per cent, are between 0.77 and 0.80 per cent of ash. It seems fair, therefore, to consider a sirup with less than 0.77 per cent of ash as adulterated if the other determinations

[a] Eighteenth Ann. Report Vermont Agr. Exper. Stat., 1904–5, p. 330.

also indicate a doubtful quality. Great care should be used in this determination not to overheat the ash.

Some analysts who have published results on maple sirup claim that the character and color of the ash are indicative of purity or adulteration. Hortvet[a] states that "an almost constant indication is a more or less distinct green color, the intensity of which varies partly with the degree of purity of the sample." Jones states that the sirup "burns readily to a white or gray ash, which is usually of a leafy, network structure." The author's experience has been that most of the samples burn easily to an ash, but that only a few show the green color, generally giving a white to gray ash. The structure of the ash depends greatly on the manner of burning. Most samples did not yield the leafy, network structure, but a light and fluffy formation. The last traces of carbon burn out very easily.

SOLUBLE AND INSOLUBLE ASH.

For insoluble ash, reduced to dry substance, the average is 0.38 per cent for the United States and 0.37 per cent for the 481 samples. The extremes in both cases are the same, 1.01 and 0.23 per cent. For soluble ash the average is 0.64 for the United States and 0.63 per cent for all. The extremes are again the same, 1.23 and 0.35 per cent. The average figures obtained by dividing the per cent of soluble ash by the per cent of insoluble ash are 1.68 for the United States and 1.70 for all samples. The extremes are practically the same, namely, 0.53 and 3.86.

The insoluble ash represents the calcium compounds and sometimes silica. The figures for this determination grouped by States and divided into classes varying by 0.10 per cent are as follows:

Insoluble ash determinations (dry basis), grouped by States.

Insoluble ash.	Number of samples.											Total.	
	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	Canada.	Number of samples.	Percentage of samples.
Per cent.													
0.23 to 0.29	3	2	6	9	2	19	31	24	24	1	15	136	28.3
.30 to .39	7	3	3	10	8	34	55	25	17	1	33	196	40.8
.40 to .49	6	.....	1	1	4	13	35	5	3	.....	20	88	18.3
.50 to .59	3	2	.....	2	1	.....	14	.....	4	1	15	42	8.7
.60 to .69	.....	1	.....	1	.....	.....	3	1	2	.....	2	10	2.1
.70 to .79	1	1	.....	.....	.....	.....	2	.....	.....	.....	1	5	1.0
.80 to .89	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.4
.90 to .99	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.2
1.00 to 1.10	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.2
Total	23	9	10	23	15	66	141	55	50	3	86	481	100.0

[a] J. Amer. Chem. Soc., 1904, **26**: 1541.

About 41 per cent of the samples had from 0.30 to 0.39 per cent of insoluble ash. Massachusetts and Vermont were the only two individual exceptions, the largest divisions containing from 0.23 to 0.29 per cent, and 28 per cent of all the samples fell in this class, while 18 per cent contained from 0.40 to 0.49 per cent of insoluble ash. Relatively few samples (12.6 per cent) have 0.50 per cent or over. Jones has never found a pure maple sirup, standard in weight, with an insoluble ash lower than 0.15 per cent, which, calculated to the dry basis, would be 0.23 per cent. None of the figures obtained were below 0.23 per cent; even the one sample with 0.68 per cent of total ash gave an insoluble ash of 0.26 per cent. It is safe to say, therefore, that a sirup with an insoluble ash of less than 0.23 per cent is adulterated, and this figure is equally as important as the total ash in judging of the purity of the sample. The percentage found may be influenced by the temperature of burning, and the calcium should be in the carbonate form, as the oxid form gives too low a figure. It is sometimes well to moisten the insoluble ash after the first burning with ammonium carbonate solution, reheat, and reweigh. An increase in weight after this treatment indicates that the oxid was present, and therefore the per cent of insoluble ash will be too low and that of soluble ash too high. The weight taken for determining the percentage of insoluble ash in such a case should be the one obtained after heating with ammonium carbonate.

The range and average of the figures for soluble ash have been given before, but as these are obtained by difference they may be affected by the limit of error of two determinations. The large figure in many cases can be accounted for by the fact that some makers use bicarbonate of soda or potash to neutralize the acidity and others use a small quantity to raise the scum, as before mentioned.

The figure[a] obtained by dividing the per cent of soluble by the per cent of insoluble ash has been considered important in determining the purity of maple products, and therefore the data obtained for this ratio are given. In nearly all cases the per cent of soluble ash exceeds that of the insoluble ash, the resultant quotient being therefore larger than 1. There are, however, 29 exceptions to this out of the 481 samples which have been tabulated.

[a] This figure has been previously termed "Ratio of insoluble to soluble ash," but to prevent any possible misunderstanding as to how the ratio is obtained the statement of "soluble ash divided by insoluble ash" is made instead.

Samples in which per cent of soluble ash divided by insoluble ash is less than unity.

Serial No.	Soluble ash. / Insoluble ash.	Serial No.	Soluble ash. / Insoluble ash.	Serial No.	Soluble ash. / Insoluble ash.
6497	0.79	6401	0.60	6904	0.53
6398	.58	6293	.85	6934	.86
6399	.88	6301	.96	6832	.89
6697	.97	6289	.94	6923	.82
6698	.87	6414	.96	6894	.85
6477	.79	6709	.57	6805	.86
6513	.91	6769	.79	6924	.58
6675	.73	6778	.98	6826	.98
6537	.98	6925	.90	6802	.78
6440	.97	6930	.95		

In most of these cases the soluble ash is nearly equal to the insoluble, but in a few samples, as serial Nos. 6398, 6675, 6401, 6709, 6904, and 6924, the insoluble is decidedly higher. It may be possible that such a condition exists because of the supersaturation of calcium malate; these being fresh sirups, the full amount of malate is not precipitated until after standing, and, were they examined later, this figure might be the same as in the other cases. Analyses of the ash for lime and potash in some cases show the preponderance of the former (see p. 87).

The results obtained by tabulating the factors expressing the relation of soluble to insoluble ash, by States and by groups covering differences of 0.25 and 0.50 per cent, show wide variations in the individual States. In the totals, 68 per cent of the samples give figures between 1 and 2.24.

Per cent of soluble ash divided by insoluble, grouped by States.

Soluble ash. / Insoluble ash.	Number of samples.											Total.	
	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	Canada.	Number of samples.	Percentage of samples.
0.00 to 0.99	3	2	.....	2	1	1	5	1	3	.....	11	29	6.0
1.00 to 1.24	3	1	.....	2	2	5	12	1	7	.....	20	53	11.0
1.25 to 1.49	3	.....	.....	1	5	11	27	3	8	1	17	76	15.8
1.50 to 1.74	4	2	2	5	5	12	16	6	4	.....	12	68	14.1
1.75 to 1.99	6	1	2	3	.....	15	28	6	8	.....	8	77	16.3
2.00 to 2.24	1	1	1	3	1	8	20	11	4	.....	5	55	11.4
2.25 to 2.49	1	.....	2	1	.....	5	10	10	7	.....	7	43	8.9
2.50 to 2.74	1	1	3	3	.....	6	12	7	2	.....	5	40	8.3
2.75 to 2.99	1	.....	.....	2	1	2	4	4	2	2	1	19	3.9
3.00 to 3.49	.....	1	.....	1	.....	1	6	4	5	.....	.....	18	3.7
3.50 to 4.00	.....	.....	.....	.....	.....	.....	1	2	.....	.....	.....	3	.6
Total	23	9	10	23	15	66	141	55	50	3	86	481	100.0

ALKALINITY OF SOLUBLE AND INSOLUBLE ASH.

The alkalinity is expressed as the number of cubic centimeters of tenth-normal alkali necessary to neutralize the ash of 100 grams of sirup. The average determination for insoluble ash is 97 cc, and

the extremes are 208 and 41 cc. One cubic centimeter of tenth-normal alkali equals 0.005 gram of calcium carbonate or 0.0028 gram of calcium oxid. The average "cc figure" expressed as grams of calcium carbonate is 0.485 and as grams of calcium oxid 0.2716, the average per cent of insoluble ash being 0.37, a figure which is midway between the calcium oxid and calcium carbonate results. There is present in most cases in the ash of maple sirup a small quantity of material that does not dissolve in the acid.

For the alkalinity of the soluble ash the average figure is 75 cc, the extremes are 122 and 41 cc; considering the alkalinity of the soluble ash to be due to potassium carbonate, the average figure would equal 0.51825 gram of potassium carbonate in 100 grams of sirup. The average per cent of soluble ash is 0.63. There are present in maple ash other soluble salts, and the alkalinity recorded may be due in part to sodium carbonate.

The figures obtained by dividing the alkalinities average 0.77, and the extremes are 1.83 and 0.21 per cent, exhibiting a much smaller range than those for the relation of soluble to insoluble ash. As is seen from the table, 77 per cent of all the samples have a figure below unity and of the remainder 17 per cent are between 1 and 1.19.

Alkalinity of soluble ash divided by that of the insoluble ash.

Ratios grouped.	Number of samples.											Total samples.	
	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	Canada.	Number.	Percentage.
0.00 to 0.39	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	0.2
.40 to .49	3	.....	.....	3	.....	.....	4	2	5	.....	7	24	5.0
.50 to .59	4	2	1	4	2	3	21	2	9	.....	14	62	12.9
.60 to .69	4	2	.....	4	3	9	31	8	5	.....	20	86	18.2
.70 to .79	2	.....	1	1	6	14	19	6	7	1	12	69	14.1
.80 to .89	5	.....	2	3	1	15	22	9	6	.....	14	77	16.0
.90 to .99	3	.....	1	2	1	12	12	9	5	.....	8	53	11.0
1.00 to 1.19	1	5	3	6	2	13	23	15	6	2	7	83	17.3
1.20 to 1.39	.....	.....	2	.....	.....	.....	6	3	5	.....	3	19	3.9
1.40 to 1.59	.....	.....	.....	.....	.....	.....	3	1	1	.....	1	6	1.2
1.60 to 1.80	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	0 2
Total	23	9	10	23	15	66	141	55	50	3	86	481	.....

MINERAL COMPOSITION OF MAPLE ASH.

GENERAL DISCUSSION.

The ash of maple sirup is composed largely of calcium and potassium carbonates. Magnesium, and sometimes manganese, are present in small quantities, but as before noted the latter is not always a constituent of maple sirup. If an appreciable amount is present, it colors the ash, as was noticed in quite a number of samples. From 8 to 10 per cent of sodium, which is a normal constituent of

maple ash, is found and more if baking soda has been used as a cleanser. Sulphate and phosphates, the latter in particular, are also normal constituents of maple ash, some samples having a comparatively large per cent, while chlorin may or may not be normally present.

Schroeder[a] has made some analyses of the ash of maple sap, which are given in the following table. The figures expressed as ratios have been calculated by the author for comparison with those given on page 85 on the finished maple sirup.

Composition of the ash of maple sap (Schroeder).

(Expressed as parts in 100 cc of sap.)

Potash (K_2O).	Sodium (Na_2O).	Magnesium (MgO).	Calcium (CaO).	Iron (Fe_2O_3).	Phosphoric acid (P_2O_5).	Ratios.	
						$\frac{K_2O}{CaO \times 100}$.	$\frac{P_2O_5}{CaO \times 100}$.
0.02708	0.00096	0.00584	0.02404	0.00050	0.00968	113	40
.93529	.00040	.00660	.02262	.00012	.00646	156	24
.03009	.00073	.00524	.01462	.00097	.00357	206	24
.03321	.00321	.00673	.02142	.00112	.00415	155	19
.01345	.00182	.00921	.02655	.00267	.00973	51	37
.01661	.00056	.00304	.01798	.00019	.00354	92	19
.01857	.00138	.00281	.00644	.00025	.00474	288	73

The ash of 100 samples, selected so that all States were represented, was analyzed, lime, potash, phosphoric acid, and sulphates being determined. The following methods of analysis were used:

METHODS OF ANALYSIS.

Ash 40 grams of the maple sirup in the usual way in a large platinum dish over a low flame and finally in a muffle. Treat the resulting ash with dilute hydrochloric acid and heat. If much remains undissolved, filter the solution and reignite the residue. Treat this residue again with dilute hydrochloric acid and heat. Combine the two filtrates and make up to a volume of 100 cc. Use aliquot portions for the individual determination as outlined.

Sulphates.—Make up a 25 cc portion to about 100 cc with water, add a few drops of hydrochloric acid and heat to boiling. While hot stir in a 10 per cent barium chlorid solution, allow to stand overnight and determine the sulphates as SO_3 by weighing the barium sulphate.

Potash.—Place a 25 cc portion in a porcelain dish and add platinum chlorid solution in excess. Evaporate the resulting liquid on a steam bath to a sirupy consistency. Wash the whole on to a filter paper with 80 per cent alcohol and wash out the excess of platinic chlorid with this reagent. Then wash the precipitate with

[a] Land. Vers.-Stationen, 1871, **14**: 136.

ammonium chlorid solution (Bulletin 107, Revised, p. 11), and finally with 80 per cent alcohol until all chlorids are removed, as indicated by testing the filtrate with silver nitrate. Dissolve the remaining yellow precipitate in hot water and wash into a platinum dish, evaporate, and after drying at 100° C. weigh as potassium platinic chlorid.

Lime and phosphoric acid.—Pour the remaining portion (50 cc) into a platinum dish and evaporate to dryness. Add a few drops of concentrated nitric acid to oxidize any phosphates present and drive off the excess of nitric acid by heating over a burner flame. Treat the dry residue with a few drops of nitric acid, then transfer to a beaker with about 50 cc of water and bring to a boil, adding a few cubic centimeters of ferric chlorid solution to combine with all of the phosphates. Then add 2 grams of dry ammonium acetate and boil the solution for two minutes. Use the filtrate for the lime determination. (In some cases the precipitate on the filter paper was dissolved in hydrochloric acid, reprecipitated with ammonium hydroxid, and this filtrate added to the filtrate for the lime determination. This extra treatment was found to be unnecessary, however, as no lime was found in the second filtrate.)

Dissolve the residue on the filter paper in nitric acid, neutralize with ammonium hydroxid, add 10 grams of ammonium nitrate, and precipitate the phosphates with molybdate solution (Bulletin 107, Revised, p. 2). Allow this precipitate to stand overnight in the cold, filter, wash with cold water, and add standard potassium hydroxid solution to dissolve it. Then titrate this solution with standard hydrochloric acid and determine the amount of phosphoric acid (P_2O_5). (See also Bulletin 107, Revised, p. 4.)

Boil down the filtrate for lime to a small volume and add ammonium hydroxid and ammonium oxalate. Weigh the precipitated calcium oxalate as calcium oxid.

Calculate all determinations to per cents of the sirup and finally to per cents of the total ash.

ANALYTICAL RESULTS.

The results of this work are given in the following table where they are grouped and arranged by States. The samples are designated by the laboratory number, so that the data given in other tables on the same samples may be compared if desired.

Analyses of ash of maple sirup.

[Parts per 100 parts of ash.]

Serial number and State.	Ash (wet basis).		Potash (K_2O).	Lime (CaO).	Phosphoric acid (P_2O_5).	Sulphates (SO_3).	Ratios.			
	Total.	Insoluble.					$\frac{K_2O}{CaO}\times 100$.	$\frac{SO_3}{CaO}\times 100$.	$\frac{SO_3}{K_2O}\times 100$.	$\frac{P_2O_5}{CaO}\times 100$.
Indiana:	*P. ct.*	*P. ct.*								
6244	0.64	0.20	48.13	17.66	4.53	5.31	273	30	11	25
6395	.84	.37	36.90	23.45	5.83	1.66	153	7	4	24
6396	.74	.31	36.22	19.46	4.59	4.19	186	21	12	23
6398	.98	.62	24.80	32.14	6.84	1.23	77	3	5	21
6474	.75	.29	40.27	17.73	3.73	1.87	227	11	4	21
6493	.68	.24	39.12	15.44	6.17	.73	253	5	2	39
6494	1.04	.52	27.60	26.25	7.50	1.54	105	5	5	29
6495	.69	.20	44.63	16.81	6.09	2.03	265	12	4	36
6496	.77	.28	40.13	17.53	7.01	1.30	229	7	3	40
Average (9)	.....	.....	37.53	20.70	5.81	2.21	181	11	6	28
Maine:										
6692	.68	.16	43.97	19.27	6.18	1.18	228	6	2	32
6694	.62	.21	40.32	22.42	5.80	2.25	180	10	5	25
6695	.83	.38	26.63	23.49	6.86	2.04	113	8	7	29
6696	.63	.21	45.24	16.98	5.40	2.06	266	12	4	32
6697	.80	.41	32.37	25.87	8.50	2.12	125	8	6	33
6713	.85	.34	37.53	21.29	5.76	1.88	176	8	5	27
Average (6)	.....	.....	37.68	21.55	6.42	1.92	175	9	5	29
Massachusetts:										
6505	.69	.23	46.81	17.54	5.22	.43	267	2	1	29
6506	.68	.20	45.00	18.38	5.00	.44	245	2	1	27
6572	.57	.16	49.82	18.60	5.79	.87	268	5	2	31
6574	.62	.21	41.13	22.74	7.09	2.09	181	9	5	31
6616	.66	.18	54.54	16.67	3.94	1.51	327	9	3	24
Average (5)	.....	.....	47.46	18.79	5.41	1.07	252	6	2	28
Michigan:										
6450	.64	.18	41.40	16.56	4.37	.78	250	4	2	27
6452	1.06	.25	40.94	20.56	4.43	.00	199	0	0	21
6454	.56	.14	49.64	21.78	5.89	1.60	228	7	3	27
6455	.75	.19	38.80	13.87	5.60	1.33	280	9	3	40
6461	.65	.24	36.31	30.77	11.54	1.39	118	4	3	37
6477	.79	.44	29.50	28.23	5.82	.76	105	3	2	21
6512	.54	.19	35.56	23.51	1.30	2.78	151	12	8	6
6514	.54	.21	40.37	16.29	6.66	1.66	247	10	4	41
6516	.69	.34	37.54	26.09	6.81	1.59	144	6	4	26
6444	.63	.23	40.63	28.25	10.63	2.38	144	8	6	38
Average (10)	.....	.....	39.06	22.59	6.30	1.59	173	7	4	28
New Hampshire:										
6656	.59	.19	35.42	16.95	8.47	2.20	209	13	6	50
6657	.58	.24	41.21	25.69	5.69	2.24	160	8	5	22
6658	.58	.24	40.17	31.90	5.69	1.20	126	3	3	18
6671	.67	.29	40.30	22.24	10.15	1.34	181	6	3	45
6675	.55	.32	34.73	36.36	4.18	1.09	96	3	3	12
6683	.55	.26	38.91	25.82	5.63	6.18	151	24	16	22
Average (6)	.....	.....	38.46	26.49	6.64	2.37	145	9	6	25
New York:										
6465	.62	.24	35.81	26.61	3.71	1.29	135	5	3	14
6478	.63	.15	37.94	14.45	3.17	.00	263	0	0	22
6528	.55	.17	41.82	18.36	5.27	2.00	227	11	4	28
6532	.63	.25	36.67	27.78	4.12	1.43	132	5	4	15
6540	.50	.18	41.00	19.00	2.60	1.00	216	5	2	14
6542	.77	.27	43.38	20.52	2.07	1.04	211	5	2	10
6571	.59	.24	34.41	31.02	4.75	1.19	111	4	3	15
6582	.63	.29	34.44	24.13	6.98	2.38	142	9	7	28
6591	.55	.21	34.73	15.27	4.55	1.82	227	12	5	29
6593	.86	.27	37.21	17.56	2.09	.93	212	5	2	12
6569	.60	.16	39.34	20.50	1.17	.00	192	0	0	6
6628	.52	.14	40.38	15.19	5.00	.96	266	6	2	33
6629	.55	.14	35.82	19.27	8.54	3.27	186	17	9	44
Average (13)	.....	.....	38.61	20.74	4.16	1.33	186	7	3	20

Analyses of ash of maple sirup—Continued.

[Parts per 100 parts of ash.]

Serial number and State.	Ash (wet basis).		Potash (K_2O).	Lime (CaO).	Phosphoric acid (P_2O_5).	Sulphates (SO_3).	Ratios.			
	Total.	Insoluble.					$\frac{K_2O}{CaO}\times 100$.	$\frac{SO_3}{CaO}\times 100$.	$\frac{SO_3}{K_2O}\times 100$.	$\frac{P_2O_5}{CaO}\times 100$.
Ohio:	*P. ct.*	*P. ct.*								
6356	.60	.17	47.66	15.66	5.17	2.50	300	16	5	33
6360	.52	.16	40.96	16.54	5.38	1.92	248	12	4	33
6375	.57	.16	41.93	18.25	11.75	2.98	229	16	7	64
6379	.55	.18	41.45	17.27	10.36	2.00	240	12	4	60
6647	.62	.28	30.80	27.74	9.51	2.42	111	8	8	34
6649	.69	.34	39.13	29.56	12.90	1.45	133	5	4	44
6679	.72	.15	40.00	13.20	1.67	0	303	0	0	13
6983	.48	.13	42.29	16.04	4.17	1.46	263	9	4	26
6985	.64	.23	39.06	18.28	2.81	1.25	213	6	3	15
6986	.67	.30	27.46	22.24	6.27	1.96	123	8	7	28
6989	.79	.24	32.15	21.26	3.30	1.89	151	9	6	15
6992	.56	.18	46.96	18.03	2.32	.00	260	0	0	13
7018	.75	.31	34.00	24.13	7.33	1.60	141	7	5	30
6441	.65	.27	39.23	19.23	5.53	1.38	204	7	3	28
Average (14)	.....	.....	38.79	19.74	6.32	1.61	196	8	4	32
Pennsylvania:										
6403	.63	.16	41.27	17.94	7.46	.95	230	5	2	42
6416	.70	.27	37.57	27.00	6.71	1.57	139	6	4	25
6428	.66	.16	36.21	16.21	4.24	1.67	223	10	4	26
6837	.78	.27	40.51	19.49	8.84	3.59	278	18	8	45
6838	.73	.16	39.18	15.20	3.56	0	258	0	0	23
6840	.67	.22	42.24	18.65	7.31	2.09	226	11	5	39
6841	.61	.17	40.49	19.35	4.26	1.31	208	7	3	22
6842	.86	.18	41.40	15.93	6.04	3.83	260	24	9	38
6846	.52	.15	46.34	21.73	5.38	1.53	213	7	3	25
6853	.69	.20	34.06	14.64	4.20	1.01	232	7	3	28
6856	.68	.25	45.59	23.38	6.91	2.64	152	11	6	29
Average (11)	.....	.....	40.44	19.05	5.90	1.83	212	9	4	31
Vermont:										
6635	.57	.17	41.93	21.58	4.03	1.22	194	6	3	18
6726	.87	.37	30.80	23.10	5.97	2.29	133	9	7	26
6729	.54	.18	38.89	21.30	3.70	1.48	182	7	4	17
6731	.55	.24	33.82	22.54	3.82	1.27	150	5	4	17
6732	.61	.14	28.52	29.18	6.55	1.96	98	6	7	22
6775	.62	.15	43.87	19.52	3.39	.97	225	5	2	17
6776	.65	.29	32.61	31.38	8.00	2.15	104	6	6	26
6777	.56	.18	40.71	16.25	2.32	1.78	250	11	4	14
6780	.55	.23	37.63	23.09	2.91	1.09	163	4	3	13
Average (9)	.....	.....	36.53	24.11	4.52	1.58	151	6	4	18
West Virginia:										
6990	.88	.23	41.47	17.61	2.95	.00	235	0	0	17
Canada:										
6816	.71	.33	30.28	30.00	6.90	1.41	101	4	4	23
6819	.64	.16	34.84	18.62	1.85	.94	187	5	3	10
6821	.90	.35	24.55	20.44	3.78	1.22	120	6	5	18
6831	.51	.20	36.08	20.20	7.06	1.96	178	9	5	35
6834	.80	.39	29.75	27.87	5.37	1.87	107	6	6	19
6889	.65	.29	32.46	28.15	5.23	2.00	115	7	6	19
6897	.72	.33	30.14	32.92	5.14	.70	92	2	2	16
6899	.53	.24	27.92	27.92	4.90	1.88	100	7	7	18
6902	.70	.34	29.86	27.57	4.14	.71	108	3	2	15
6905	.56	.19	38.93	21.25	1.79	.53	183	2	1	8
6906	.72	.33	27.36	33.05	4.03	1.53	83	4	5	12
6909	.56	.24	35.36	26.60	3.40	.71	133	3	2	13
6915	.58	.15	40.69	16.38	5.68	1.21	248	7	3	34
6920	.51	.16	40.98	25.88	4.12	2.55	158	10	6	16
6926	.59	.24	32.37	20.68	3.39	.67	156	3	2	16
6928	.74	.28	32.84	26.48	1.08	.00	124	0	0	4
Average (16)	.....	.....	32.77	25.25	4.24	1.24	129	5	4	13
Total average (100)	.....	.....	38.07	21.88	5.39	1.59	174	7	4	24
Maximum	.....	.....	54.54	36.36	12.90	6.18	327	30	16	64
Minimum	.....	.....	24.55	13.20	1.08	.00	77	0	0	4

DISCUSSION OF TABULATED DATA.

Potash.—The average percentage of potash for the 100 samples is 38.07 per cent, with a range of from 24.55 to 54.54 per cent. The results on the Massachusetts samples show the highest percentages, the State average being 47.46 per cent, while the Canadian samples have the lowest average potash content, namely, 32.77 per cent. With the exception of these, all of the State averages are very near the general average figure.

Lime.—The average lime content of the ash is 21.88 per cent with extremes of 13.20 and 36.36 per cent. The state averages show that the northern States and Canada have the highest percentages, namely, New Hampshire, 26.49 per cent; Vermont, 24.11 per cent; Canada, 25.25 per cent; Michigan, 22.59 per cent; and Maine, 21.55 per cent. The West Virginia sample shows only 17.61 per cent. The relation between the lime and the insoluble ash is constant, providing the ash of the maple sample does not contain much silica.

Per cent of potash divided by per cent of lime.—The average figure for this ratio is 174, the highest noted being 327. This average figure corresponds to the figure obtained by dividing the per cent of soluble by the per cent of insoluble ash as given on page 79, the average being 1.70 and the maximum 3.86. Of the 100 samples there were 5 cases in which the percentage of lime was higher than that of potash, giving a ratio below 100. These are No. 6398 in Indiana, with a figure of 77; No. 6675 in New Hampshire, 96; No. 6732 in Vermont, 98; and Nos. 6897 and 6906 in Canada, with ratios of 92 and 83, respectively. This preponderance of lime over potash, as before stated, is probably due to a supersaturation of malate of lime in the new sirup, a part of which may be thrown down as a sediment on long standing. In most of the cases cited the per cent of insoluble ash is higher than that of soluble ash, which would indicate the explanation given.

Among the ratios calculated from Schroeder's tables of maple-sap ash there are two below 100, showing that in these samples there was more lime than potash. The other ratios are very near those found for the sirup, with two exceptions, Nos. 288 and 206 being lower. This may be accounted for by the fact that more of the lime than potash is removed in the evaporation of the sap to sirup. In both cases the ratio is fairly constant.

Phosphoric acid.—The average content of phosphoric acid is 5.39 per cent, with extremes of 1.08 and 12.90 per cent. Six samples out of the 100 show very high percentages as compared with the others: Nos. 6461 and 6444 of Michigan, with 11.54 and 10.63 per cent, respectively; No. 6671 of New Hampshire, with 10.15 per cent; and Nos. 6375, 6379, and 6649 of Ohio, with 11.75, 10.36, and 12.90 per cent, respectively. The manufacturing and inspection data show that four

of these samples came from small camps where the sap was boiled in unprotected kettles in the open; Nos. 6375 and 6379, however, came from Geauga County, Ohio, where the groves are large and the sirup is manufactured under cleanly conditions. As a whole the results do not vary much from the average figure of 5.39 per cent.

Per cent of phosphoric acid divided by per cent of lime.—The average figure for this ratio is 24, the extremes being 64 and 4; the higher figures result when the percentage of phosphoric acid is abnormally high and the low figure when it is very low. Comparing these data with those obtained for the sap ash, a striking similarity is shown, only one having a very high ratio, namely, 73.

Sulphates.—The average figure for sulphates (SO_3) is 1.59 per cent with extremes of 6.18 per cent and zero. In seven samples no precipitate occurred with barium chlorid; in six samples the per cent of sulphates was much higher than the average, Indiana samples Nos. 6244 and 6396 averaging 5.31 and 4.19 per cent, respectively; New Hampshire sample No. 6683, 6.18 per cent; New York No. 6629, 3.27 per cent, while Pennsylvania samples Nos. 6837 and 6842 had 3.59 and 3.83 per cent, respectively. The first three noted are abnormally high and were obtained from small camps where not much care was taken in the manufacture.

Sulphates divided by calcium oxid.—The average figure for this ratio is 7; the extremes are zero and 30. In 21 cases this figure is 10 or more.

Sulphates divided by potassium oxid.—The average figure for this ratio is 4, with extremes of zero and 16. In only three cases is the number over 10.

The data obtained in this work corroborated those obtained in other similar investigations, as is shown in the following table:

Compiled data on the mineral constituents of the ash of maple sirup.

[Parts per 100 parts of ash.]

Chemist.	Potash (K_2O).	Lime. (CaO).	Phosphoric acid (P_2O_5).	Sulphates (SO_3).	Ratios.			
					$\frac{K_2O}{CaO}\times 100.$	$\frac{SO_3}{CaO}\times 100.$	$\frac{SO_3}{K_2O}\times 100.$	$\frac{P_2O_5}{CaO}.$
Jones[a]	31.97	18.03	.....	2.30	177	12	7	.....
Do	30.00	20.00	.....	1.91	150	9	6	.....
Do	38.98	23.98	.....	1.06	163	4	3	.....
Do	35.90	19.81	.....	.68	181	3	2	.....
Do	36.22	20.76	.....	1.58	174	7	4	.....
Do	35.48	21.86	.....	1.74	162	9	5	.....
Hortvet[b]	31.58	18.60	1.64	2.31	170	12	7	9
Do	30.87	20.35	4.67	2.42	152	12	8	23

[a] Vermont Agr. Exper. Sta. Rept., **18**: 331.
[b] J. Amer. Chem. Soc. 1904, **26**: 1541.

The data as a whole indicate that the ash of maple sirup is of a rather constant composition. Here again the ash analysis of the Canadian sirup does not differ much from that of the United States product.

LEAD NUMBER.

The average lead numbers of the individual States vary quite markedly. In the following table the States are arranged with regard to the magnitude of the basic and neutral lead numbers:

Averages by States, including Canada, of the basic and neutral lead numbers.

	Basic lead number.		Neutral lead number.
West Virginia	3.82	West Virginia	1.17
Indiana	3.00	Indiana	1.00
Ohio	2.99	Ohio	.99
Pennsylvania	2.73	Pennsylvania	.86
New Hampshire	2.63	Massachusetts	.72
Michigan	2.60	Maine	.70
Canada	2.55	New York	.70
Massachusetts	2.46	Michigan	.68
Vermont	2.41	New Hampshire	.65
New York	2.39	Vermont	.54
Maine	2.33	Canada	.54

The first four States stand in the same order under both headings, indicating a probable relation between the precipitate formed with basic and with neutral lead acetate. The remaining six States, however, and Canada do not show any relation of this kind.

The precipitate formed with the basic lead acetate is quite characteristic, varying from white to gray in color (yellow if the maple sirup is very dark) and having the appearance of being composed partly of fine crystals. It settles rather quickly, without becoming compact, and might be described as having a tendency to be flocculent, like aluminum hydroxid. The precipitate with neutral lead acetate is more flocculent, of lighter weight, and a little darker colored than that formed by the basic lead, and very seldom has a crystalline appearance. It was thought that some relation might exist between these two numbers, but the investigation fails to establish this point. The neutral lead figure is about one-third of the basic; dividing the basic by the neutral, the average figures obtained range from 3 to 4.4.

The average basic lead figure for the 481 samples is 2.70, figured to dry substance, with extremes of 4.4 and 1.76; for the neutral number the average is 0.79, with extremes of 1.65 and 0.13. Tabulating the basic and neutral lead numbers by States and grouping them by differences of 0.25 and 0.50, the following results are obtained.

Lead number determinations.

BASIC LEAD NUMBER.

Lead numbers grouped.	Number of samples.											Total.	
	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	Canada.	Number of samples.	Percentage of samples.
0.00 to 1.84	....	[a]1	....	....	....	....	....	....	....	....	....	1	0.2
1.85 to 1.99	1	....	2	2	1	8	3	4	5	....	7	33	6.8
2.00 to 2.24	....	4	3	3	1	11	5	7	18	....	22	74	15.4
2.25 to 2.49	3	1	1	4	4	25	16	9	9	....	16	88	18.2
2.50 to 2.74	4	1	....	5	1	11	22	11	6	....	15	76	15.6
2.75 to 2.99	4	1	3	6	5	9	32	7	6	....	12	85	17.6
3.00 to 3.24	4	1	1	....	2	2	23	9	5	....	8	55	11.4
3.25 to 3.49	3	....	....	2	1	....	13	2	....	....	4	25	5.2
3.50 to 3.74	1	....	....	1	....	....	18	5	1	2	....	28	5.8
3.75 to 3.99	2	....	....	....	....	....	6	....	....	....	2	10	2.1
4.00 to 4.50	1	....	....	....	....	....	3	1	....	1	....	6	1.2
Total	23	9	10	23	15	66	141	55	50	3	86	481	100.0

NEUTRAL LEAD NUMBER.

0.00 to 0.19	....	....	....	....	....	....	....	....	....	....	1	1	0.2
.20 to .29	....	2	....	....	....	....	....	....	1	....	5	8	1.7
.30 to .39	....	....	....	2	1	....	....	....	9	....	7	19	3.8
.40 to .59	2	....	3	6	3	21	4	5	23	....	45	112	24.8
.60 to .79	2	3	4	9	9	26	24	11	14	....	23	125	26.2
.80 to .99	9	2	2	4	2	18	45	30	2	....	5	119	23.3
1.00 to 1.19	5	2	1	2	....	1	42	7	1	1	....	62	12.8
1.20 to 1.39	2	....	....	....	....	....	21	2	....	2	....	27	5.6
1.40 to 1.59	3	....	....	....	....	....	3	....	....	....	....	6	1.2
1.60 to 1.80	....	....	....	....	....	....	2	....	....	....	....	2	.4
Total	23	9	10	23	15	66	141	55	50	3	86	481	100.0

[a] Basic lead number 1.76.

In the total column, it is seen that 78 per cent of the samples have a basic lead number between 2 and 3.25. One sample from Maine, No. 6693, has a lead number of only 1.76, which is fully 0.1 lower than any of the other figures, the next lowest being one sample with a lead number of 1.85, and a few with a number of 1.86. The Maine sample is therefore very abnormal, and in judging of the purity of a maple sirup 1.85 and not 1.76 should be the minimum basic lead number. The lead numbers of some of the States—for example, Maine, Massachusetts, and New York—cover a comparatively narrow range, while others, especially Indiana, Ohio, and Pennsylvania, vary from 1.85 to 4.50. The lead numbers of the Canadian samples correspond closely with those of Vermont and their general average is lower than that of the samples from the central portion of the United States.

Of the neutral lead acetate numbers, 87 per cent fall between 0.4 and 1.19, only 9 samples having lead number below 0.3 and 28 below 0.4. Here, again, the lowest figure (0.13) is far below any of the others, and can hardly be considered as a normal minimum in judging of the purity of a sirup.

MALIC-ACID VALUE.

The two methods yielded values whose average differed by about 0.2. The word "value" is properly used in this connection, as the methods do not purport to separate the malic acid completely. Calcium, either as the chlorid or acetate, in the presence of alcohol, will precipitate other acids, and hence the figure obtained does not represent true malic acid. No sufficiently quick and accurate method for separating and determining this acid in the presence of other acids and of organic matter is known.

The average of all determinations made by the modified calcium chlorid method of the Association of Official Agricultural Chemists is 0.84, the maximum being 1.60 and the minimum 0.29; by the calcium acetate method the average is 1.01, the determinations varying from 1.82 to 0.21.

The tabulated results of the two methods, arranged by States and grouped, are given in the following table:

Malic-acid value determined by two methods and results grouped by States.

ASSOCIATION METHOD.

Malic acid values grouped.	Number of samples.											Total.	
	Indiana.	Maine.	Massachusetts.	Michigan.	New Hampshire.	New York.	Ohio.	Pennsylvania.	Vermont.	West Virginia.	Canada.	Number of samples.	Percentage of samples.
0.00 to 0.29	....	....	....	....	....	....	[a] 1	....	....	....	....	1	0.2
.30 to .39	....	1	....	....	....	....	....	....	....	....	1	2	.4
.40 to .49	3	1	....	....	....	1	3	....	3	....	....	11	2.3
.50 to .59	1	....	1	1	....	7	4	....	7	....	8	29	6.0
.60 to .69	4	1	1	7	3	10	10	3	11	....	9	59	12.3
.70 to .79	3	2	2	2	1	17	15	6	11	....	29	88	18.3
.80 to .99	5	2	4	10	9	27	55	8	12	1	30	163	34.1
1.00 to 1.24	5	2	2	2	2	3	44	27	5	1	9	102	21.2
1.25 to 1.49	2	....	....	....	....	1	7	11	1	1	....	23	4.8
1.50 to 1.75	....	....	....	1	....	....	1	....	....	....	....	2	.4
Total	23	9	10	23	15	66	[b] 140	55	50	3	86	[b] 480	100.0

COWLES METHOD.

0.00 to 0.29	....	....	....	....	....	....	....	....	....	....	[c] 1	1	0.2
.30 to .39	....	1	....	....	....	....	....	....	....	....	....	1	.2
.40 to .49	....	1	....	....	....	....	....	....	....	....	....	1	.2
.50 to .59	....	....	....	....	....	....	....	....	1	....	2	3	.6
.60 to .69	....	....	1	....	1	3	5	....	5	....	5	20	4.2
.70 to .79	....	....	1	2	1	7	4	2	12	....	14	43	8.9
.80 to .99	3	3	4	11	5	37	26	25	18	....	38	170	35.4
1.00 to 1.24	12	2	3	8	7	17	75	27	7	1	23	182	38.1
1.25 to 1.49	4	2	1	2	1	1	21	1	5	2	3	43	8.9
1.50 to 1.74	2	....	....	....	....	1	8	....	2	....	....	13	2.7
1.75 to 2.00	2	....	....	....	....	....	1	....	....	....	....	3	.6
Total	23	9	10	23	15	66	[b] 140	55	50	3	86	[b] 480	100.0

[a] 0.29 malic-acid value. [b] One determination lost. [c] 0.21 malic-acid value.

The table shows that only three samples examined by the calcium chlorid or association method have a malic acid value below 0.40, about 86 per cent of the total number falling between 0.60 and 1.24. Considering the averages of the individual States, the greatest number lie between 0.80 and 0.99. Jones [a] states that with a sirup weighing 11 pounds to the gallon the malic acid value should not be less than 0.40. Calculating this figure to the dry basis gives 0.61, and the data obtained show 43 samples, or 8.9 per cent, below this limit. The method used in making this determination is somewhat different from that used by Jones, hence the two sets of figures can not be readily compared. The amount of ammonia added greatly influences the results and therefore the directions must be carefully and implicitly followed.

By the Cowles method the results in the individual States do not show such a wide range. Only two samples are below 0.40, and to these may be added 4 samples whose malic acid value lies between 0.40 and 0.59. A safe lower limit by this method would be 0.60 on the dry basis. The greatest number of samples, 73 per cent, have a malic acid value between 0.80 and 1.24. This method gives a solution the precipitate of which readily separates in a short time, and furthermore the blanks from the calcium acetate solution are more constant and smaller than those from the calcium chlorid. In most of the work chemically pure chlorid was used that had been recrystallized and dried in order to reduce the size of the blanks.

As stated before, the results by the Cowles method average higher than those obtained by the association method. Dividing the results of 480 samples on this basis, it is seen that 29 samples give a higher malic acid value by the association method, in 5 cases they are equal, and on 446 samples the calcium chlorid results are lower.

Jones states that the results obtained by using calcium chlorid or calcium acetate will be the same if the same amount of ammonia and the same quantity and strength of alcohol are added and there is the same degree of washing. To effect this, he proposes to modify the calcium chlorid method by using one drop of ammonium hydroxid, 100 cc of 95 per cent alcohol, heating for thirty minutes, and washing with 85 per cent alcohol to a total volume of 180 cc. In other words, the varying results by the two methods seem to be due to the variation in manipulation and not to the fact that the calcium acetate precipitates all of the malic acid, while the calcium chlorid does not, as is claimed by Cowles.[b]

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[a] Vermont Agr. Exper. Sta., Eighteenth Ann. Rept., 1905, p. 330.

[b] J. Amer. Chem. Soc., 1908, **30**:1285.

FACTORS INFLUENCING THE CHARACTER OF THE FINAL PRODUCT.

EFFECT OF THE RUN ON THE CHARACTER OF THE PRODUCT.

As has been said, the last runs of sirup generally give a darker colored sirup than the first ones. Some makers maintain, however, that as light colored a sirup can be made from the last runs of sap as from the first. This is possible under some conditions, as Edson's work shows that he obtained as light colored and mild flavored a sirup by tapping at the end of the season, but with old holes and under the usual manufacturing conditions the last sirup made is generally darker. The claim is also made that the malate of lime is more abundant during the last of the season, and this statement seems to be borne out by the present investigation, as is shown by the following tabulation:

The composition and color of maple sirup as effected by runs.[a]

COMPARISON OF SIRUP MADE FROM FIRST AND MIDDLE RUNS OF SAP.

State.	First run.						Middle run.					
	Serial No.	Color.	Total ash.	Insoluble ash.	Winton lead number.	Malic acid.	Serial No.	Color.	Total ash.	Insoluble ash.	Winton lead number.	Malic acid.
			P. ct.	*P. ct.*					*P. ct.*	*P. ct.*		
New Hampshire	6680	5	0.68	0.26	2.22	0.66	6675	11	0.97	0.56	2.26	1.13
Maine	6695	8	1.20	.55	2.55	1.20	6696	7	.90	.30	2.09	.90
New York	6565	7	.85	.30	2.61	.89	6568	7	.78	.34	2.32	.88
Ohio	6294	8	1.01	.38	2.67	1.16	6295	8	1.03	.37	2.87	1.13
Do	6282	6	1.04	.29	3.00	1.17	6283	6	1.04	.29	2.96	1.21
Do	6262	9	1.14	.46	3.28	1.03	6263	8	1.12	.46	3.05	1.13
Do	6300	9	1.36	.65	3.71	1.66	6301	9	1.45	.74	4.24	1.74
Do	6305	9	1.07	.40	2.99	1.13	6306	10	1.14	.47	3.11	1.07
Do	6352	8	1.08	.38	2.98	1.03	6354	6	1.18	.49	2.71	1.18
Do	6690	5	.88	.38	2.11	1.04	6689	7	.97	.43	2.24	1.10
Vermont	6633	8	.91	.34	2.00	1.47	6634	6	.92	.36	2.12	1.64
Do	6610	6	.93	.28	2.14	.95	6611	8	1.07	.43	2.63	1.15
Average		7	1.01	.39	2.69	1.12	Average.	8	1.05	.44	2.72	1.19

COMPARISON OF SIRUP MADE FROM MIDDLE AND LAST RUNS OF SAP.

State.	Middle run.						Last run.					
	Serial No.	Color.	Total ash.	Insoluble ash.	Winton lead number.	Malic acid.	Serial No.	Color.	Total ash.	Insoluble ash.	Winton lead number.	Malic acid.
			P. ct.	*P. ct.*					*P. ct.*	*P. ct.*		
Ohio	6689	7	0.97	0.43	2.24	1.10	6691	8+	1.20	0.54	2.67	0.88
Do	6256	8	.90	.24	2.28	.82	6971	10	1.17	.27	3.12	.97
Do	6372	8	.88	.30	2.20	.91	6982	8+	1.24	.41	3.54	1.21
Do	6380	9	.96	.37	2.67	.99	6981	8	1.21	.55	3.43	1.19
Average		8	.93	.33	2.35	.95	Average.	9	1.20	.44	3.19	1.06

[a] The sample placed on one line—i. e., Nos. 6680 and 6675, Nos. 6695 and 6696, etc.—are from the same maker.

The composition and color of maple sirup as affected by runs—Continued.

COMPARISON OF SIRUP MADE FROM FIRST AND LAST RUNS OF SAP.

State.	First run.						Last run.					
	Serial No.	Color.	Total ash.	Insoluble ash.	Winton lead number.	Malic acid.	Serial No.	Color.	Total ash.	Insoluble ash.	Winton lead number.	Malic acid.
			P. ct.	P. ct.					P. ct.	P. ct.		
Ohio	6360	6	0.93	0.29	2.45	0.67	6976	12	1.03	0.34	3.06	0.88
Do	6361	8	.94	.32	1.99	.90	6983	6	.77	.24	2.64	.82
Do	6363	6	.81	.24	2.42	.63	6975	9	.98	.26	2.96	.99
Do	6365	6	.93	.32	2.54	1.02	6986	6	1.00	.45	2.97	1.01
Do	6366	5	.89	.38	2.80	.77	6985	5	.94	.34	2.75	.96
Do	6367	7	.99	.34	2.77	1.07	6991	6	1.00	.41	3.09	1.12
Do	6369	8	.95	.31	2.39	1.01	7018	9+	1.28	.53	3.69	1.24
Do	6970	6+	.92	.35	2.87	1.00	6977	7	1.03	.43	3.54	1.22
Do	6377	9	1.05	.36	2.78	1.17	6978	9	1.02	.37	3.01	1.05
Do	6379	8	.82	.27	2.74	.68	6987	8+	.92	.38	2.85	1.03
Do	6440	9	.96	.49	2.49	1.09	6973	6+	.96	.24	2.58	.83
Do	6442	8	.99	.44	2.48	1.03	6992	5	.84	.27	2.75	.96
Do	6649	7	1.10	.54	3.25	1.27	6979	7	1.14	.24	3.10	1.03
Do	6651	11	1.23	.39	3.71	1.03	6988	15	1.29	.41	3.51	1.14
Do	6652	13	1.05	.47	3.18	1.08	6984	13	1.14	.47	3.86	1.25
Do	6254	8	.88	.33	2.71	1.30	6989	9	1.21	.36	3.73	1.22
Do	6253	9	.78	.23	2.42	.86	6980	11	1.18	.28	3.63	1.11
Do	6690	5	.88	.38	2.11	1.04	6691	8+	1.20	.54	2.67	.88
Indiana	6396	8+	1.09	.46	2.77	1.10	6397	9+	1.25	.59	3.20	1.28
West Virginia	6653	7+	1.10	.29	3.61	1.22	6990	10	1.29	.34	3.65	1.29
Michigan	6454	7	.82	.23	2.27	.95	6455	12	1.14	.29	2.78	.87
Average		7+	.96	.35	2.70	.99	Average.	9	1.08	.37	3.14	1.05

The preceding tabulation has been prepared from the data given in the detailed table on page 67. The serial number of the sample and the State from which it came are given so that the samples may be identified and the other data compared. The points covered in this table are color, total ash, insoluble ash, basic lead number, and the Cowles malic acid value. The two samples on the same line, reading across the page, are from the same maker. The first part of the table is a comparison of sirup made from first runs of sap and from middle season runs. Considering the averages, the color of the middle run sirup is one number darker than the first, increasing from 7 to 8. The ash has increased only 0.04 per cent and the insoluble ash has increased practically the same amount, namely, 0.05 per cent. This figure would seem to indicate the presence of a little more lime salts or malate of lime. The lead numbers show an increase of 0.03 per cent and the malic acid value 0.07 per cent. As a whole, the increases are rather small, as would be expected.

Considering the second section of the table, namely, the comparison of sirups from middle runs and from last runs, another increase of one point in color is found, namely, from 8 to 9. The total ash shows an increase of 0.27 per cent and the insoluble ash a gain of only 0.11 per cent. This again indicates more lime salts in the sirup of the last runs. The lead number has risen from 2.35 to 3.19, an increase of 0.84 and the malic-acid value shows a gain of 0.11. In every deter-

mination there has been a much larger increase than was noted between the sirups made from first and middle runs.

In the third part of the table, the figures for first and last runs are given and show that there is a material difference in the color of these runs in some individual cases, and the average shows a change from 7+ to 9. The per cent of ash has increased from 0.96 to 1.08, but in this case the insoluble ash does not show the same relative increase, being only 0.02 per cent. The lead number has risen from 2.70 to 3.14 per cent and the malic acid value from 0.99 to 1.05. With the exception of insoluble ash and the malic acid value all of the determinations show a greater increase than in the two other comparisons. It is clearly shown, however, that the sap run has a decided effect on the total ash and the malic acid content of the maple sirup, the latter being shown by the increase in the lead number as well as by the malic acid value. As regards taste, there is not much difference between the first and middle runs, but between the first and last runs the change is marked.

EFFECT OF CLEANSING ON THE COMPOSITION OF SIRUP.

Samples of sirup were collected before the addition of milk or white of egg and again after adding these cleansing agents and skimming. The results are tabulated in the following table:

Composition and color of maple sirup as affected by cleansing agents.

State.	Cleansing agent.	Serial No.	Sirup before cleansing.						Sirup after cleansing.						
			Color.	Total ash.	Insoluble ash.	Lead number.	Malic acid.	Protein.[a]	Serial No.	Color.	Total ash.	Insoluble ash.	Lead number.	Malic acid.	Protein.[a]
				P. ct.	*P. ct.*			*P. ct.*			*P. ct.*	*P. ct.*			*P. ct.*
Ohio	Milk	6252	8	0.79	0.27	2.45	0.78	.....	6253	9	0.78	0.23	2.42	0.86	.....
Do	Eggs	6255	8	.98	.39	2.99	1.10	.....	6254	8	.88	.33	2.71	1.30	.....
Do	Milk	6257	7	.86	.24	2.31	.89	.....	6256	8	.90	.24	2.28	.82	.....
Do	...do	6332	8	1.01	.40	2.77	1.09	.....	6333	8	1.22	.42	3.23	1.25	.....
Do	...do	6336	6+	1.39	.51	3.55	1.13	.....	6335	7	1.22	.42	3.19	1.34	.....
Do	...do	6353	8	1.12	.38	2.37	1.02	.....	6352	8	1.08	.38	2.98	1.03	0.094
New York	...do	6464	7	.92	.31	2.34	.85	0.040	6465	7+	.92	.36	2.35	1.08	.055
Do	...do	6470	7	.97	.33	3.05	1.13	.....	6471	7	1.04	.48	2.29	1.13	.055
Do	...do	6630	8	.91	.33	2.14	1.31	.094	6629	7	.94	.24	2.84	.97	.094
Do	Strain	6541	8	.94	.31	2.30	.96	.081	6542	8	1.12	.39	2.52	1.04	.094
Average			7+	.99	.35	2.63	1.03	.....	.....	7+	1.01	.35	2.68	1.08	.....

[a] Determinations made by T. C. Trescot.

These data show but little difference in the amounts of ash, insoluble ash, lead number, and malic acid value. The protein in two out of three cases shows a slight percentage increase. The average color is the same in both cases, but the individual samples show that the addition of these cleansers lightened two samples and darkened four, while four remained the same. It is thus seen that

such cleansing does not lighten the color as is claimed by many makers. The total ash is very slightly higher after cleansing, the average increasing from 0.99 to 1.01 per cent. The soluble ash also increases, but the insoluble ash does not, as one would naturally expect. The lead number and the malic acid value are slightly raised by the treatment. The samples of sirup before cleansing had not been passed through felt or other filters, but were allowed to settle, hence they were cloudy but cleared after adding the cleansers. In order to make a perfectly fair comparison of general appearance the samples should have been filtered and then compared with samples cleansed by egg and milk.

The percentage of nitrogen was not determined until late in the investigation and some of the samples were not available for test. In only three cases were the samples comparable and in these, after cleansing, there was a slight increase in protein in two cases and the same percentage in one.

On the whole, it may be said that there is no change in composition of the maple sirup, other than the slight increase of protein, by such cleansing, but its use is of questionable benefit since the same results can be attained by filtering.

EFFECT OF SEASONAL VARIATIONS FROM YEAR TO YEAR.

The composition of maple sirup is said to vary from year to year. Some makers note an annual variation in the amount of "niter" present, while others of equal repute disagree with this statement. It is true that in some years the season of tapping is much longer than in others, and when a hard winter suddenly breaks into a warm spring very little sirup or sugar can be made. The quantity of sap is also directly influenced, seasons being the same, by the quantity of leaves on the tree the year before. Should a pest of insects or caterpillars destroy the leaves of the maple trees during the summer, the flow of sap is diminished and the flavor of sirup and sugar produced is considerably altered. Such a condition occurred in Franklin County, Me., during the summer of 1908, and the samples collected were noted to have a bitter taste not characteristic of true maple. The effect of this condition on the composition of the maple sirup has not been determined.

While it is true that the extremes in determinations may be caused or influenced by all of these conditions, yet pure maple sirup will not fall below a certain ash content or malic-acid figure. From both the physiological and chemical points of view these considerations are of interest. Some six samples of 1908 maple sirup were collected with the 1909 samples from individual makers and are tabulated for comparison:

Composition of 1908 and 1909 maple sirup from the same makers.

State and serial Number.	Description of sample.	Color.	Total ash.	Insoluble ash.	Lead number.	Malic acid.
Indiana:			*Per cent.*	*Per cent.*		
6497	1908 sirup	16	1.04	0.58	3.30	1.11
6492	Middle run 1909.	10	.88	.36	3.00	.85
Pennsylvania:						
6855	1908 sirup	13	1.16	.38	2.90	.97
6854	First run 1909.	6+	1.10	.32	3.17	1.09
6417	1908 sirup	8	.87	.29	2.95	.73
6418	First run 1909.	6	.95	.29	2.49	1.03
6425	1908 sirup	8	.91	.42	2.04	.91
6428	First run 1909.	9	.92	.24	2.44	.85
6421	1908 sirup	13	1.00	.39	2.59	1.13
6420	First run 1909.	7	.90	.30	2.40	1.15
Vermont:						
6725	1908 sirup	7	.81	.31	2.54	.71
6726	Last run 1909.	12	1.30	.55	2.85	1.26

In four of the six cases the 1908 sirup is darker in color than the 1909, in the other two the reverse is noted. The ash content, insoluble ash, lead number, and malic-acid value vary so little that definite conclusions can not be drawn.

COMPARISON OF SIRUPS FROM COVERED AND UNCOVERED SAP BUCKETS.

The question of covering sap buckets has been already discussed (see p. 11). In the course of this investigation opportunity was afforded at one camp in New York to make sirup from the sap collected from both open and covered buckets. The results indicate what has previously been said, namely, that covered buckets give a lighter-colored sirup. A slight difference in composition is also noted.

Comparison of sirups made from sap collected in covered and uncovered buckets (New York).

Serial No.	Kind of bucket.	Color.	Ash.		Lead number.	Malic acid.
			Total.	Insoluble.		
6543	Uncovered	6+	1.04	0.36	2.07	0.85
6544	Covered	6	.87	.32	1.88	.79

The color difference is slight, but the ash content of the sirup from the uncovered buckets is greater than from the covered ones. This increase occurs in the soluble ash, as there is only 0.04 per cent difference in the insoluble ash of the two samples. There is a marked difference in the lead numbers, but not in the malic-acid values. More work should be done on this point, but the results on these two samples indicate that the use of uncovered buckets, which allow the rain, washings of the trees, and insects to enter, influences both the color and the composition of the sirup, which would be expected.

EFFECT OF ENVIRONMENT ON COMPOSITION.

CANADIAN SIRUP AS COMPARED WITH UNITED STATES SIRUP.

Very little maple sirup is imported into the United States from Canada, since the duty is the same as for sugar (4 cents a pound), and the importers prefer to handle the latter. The Bureau of Statistics of the Department of Agriculture gives the following figures on imports of maple products during the past four years:

Maple products imported, from 1906 to 1909, inclusive.

Year ending June 30—	Pounds.	Import value.
1906	1,615,139	$109,764
1907	2,125,810	141,306
1908	2,835,150	225,863
1909	1,782,637	136,268

It is noted that there was a steady increase in the importation up to 1909, when there was a decrease of nearly one-half.

Eighty-six maple sirups were collected in the Province of Quebec during this investigation. These were taken partly from the receiving station of the Maple Tree Producers' Association, at Waterloo, and partly from the makers' camps. The season was nearly at a close when Canada was visited, so that no extensive inspection of individual camps could be made; but inasmuch as each maker must sign a guaranty that his sirup is pure and unadulterated, and furthermore, all sirups are liable to inspection from time to time, it was thought that such samples could be relied upon, and that, having been chosen at random, they would be fairly representative.

The maple sirup and sugar industry of Canada is confined principally to the four provinces lying just north of our border, beginning at eastern Minnesota with Ontario and proceeding eastward through Quebec, New Brunswick, and Nova Scotia. The Province of Quebec is north of eastern New York, Vermont, New Hampshire, and Maine; New Brunswick is east of Maine, and Nova Scotia still farther east. The Canadian census of 1901 gives the output of maple products as follows:

Province:	Pounds.
Quebec	13,564,819
Ontario	3,912,640
New Brunswick	207,450
Nova Scotia	112,496
All others	7,520
Total	18,804,925

It is seen that over 70 per cent of the Canadian maple products come from the Province of Quebec. The native forest of these provinces of southern Canada is the hard maple, and this section, which is probably the oldest in the production of maple products, seems to have made fewer improvements than any other maple region. The patent evaporator, however, is fast taking the place of the iron kettle, and the metal bucket, both covered and uncovered, is superseding the wooden firkin or hollowed log; yet in the northern sections, where much maple sugar is produced, the very crude apparatus of the Indians is still used. It is from these sections that many of the dark-colored, strong-flavored products come, and they are the result of crude methods and lack of care rather than of environment or local conditions of soil and climate. Dark, strong maple sirup is no more in demand in Canada than it is in the United States. The price paid is based on color, appearance, etc., the lighter grades obtaining the higher price. Only the mixers desire a dark sirup.

As the samples collected represent only the one province of Quebec, comparison can only be made with the product of the United States as a whole and with the adjacent region in the United States, namely, New York, Vermont, New Hampshire, and Maine.

Average analyses of maple sirups of Canada, of the Northern States, and of the whole United States.

Determinations.	Canada.	New York, Vermont, New Hampshire, Maine.	United States.
Number of samples	86	140	395
Color	10	8+	8+
Moisture (per cent)	34.34	34.42	34.19
Total ash (per cent)	.95	.93	1.02
Soluble ash (per cent)	.56	.59	.64
Insoluble ash (per cent)	.39	.34	.38
Per cent of soluble ash÷per cent of insoluble ash	1.45	1.73	1.68
Alkalinity of soluble ash (cc)	.69	.69	.76
Alkalinity of insoluble ash (cc)	.96	.87	.97
Alkalinity of soluble ash÷alkalinity of insoluble ash	.72	.79	.78
Basic lead number	2.55	2.42	2.72
Neutral lead number	.54	.64	.82
A. O. A. C. malic acid	.79	.79	.85
Cowles malic acid	.91	.94	1.04

In general the average figures for Canada are a little higher than for the adjoining States but lower than the general average for the United States. Considered individually the average color of Canadian sirups is much darker than that of the United States or of the adjacent States. As was before mentioned, this is probably due to the fact that there has been more advance in the United States in cleanly methods of handling and boiling sap. The climatic conditions and the soil can not account for the production of dark sirups, for among the Canadian samples are many sirups of as light a color as those of the United States. The per cent of moisture in the three averages is

practically the same. In per cent of total ash, figured to dry substance, the Canada samples are 0.02 per cent higher than those from the States adjoining and 0.07 per cent lower than the United States average. The average insoluble ash of Canada is 0.05 per cent higher than that of the States adjacent and 0.01 per cent higher than the figure for the United States. The alkalinities and malic acid values compare favorably. The basic lead number for the Canadian samples is about halfway between the other two while the neutral lead number is lower. There seems to be no reason why there should be any difference between Canadian maple sirup and that made across the border in the United States, yet an idea prevails that Canadian sirup is stronger than the domestic product.

COMPARISON OF SIRUPS FROM THE VARIOUS STATES.

For further comparison of the effect of environment on the quality of the product the average analyses of the samples from the several States have been tabulated and show slight variations in some cases and rather marked ones in others. In the tabulation the States are arranged according to latitude, the ones farther south standing first.

Average analyses of samples by States.

Determinations.	West Virginia.	Indiana.	Ohio.	Pennsylvania.	Michigan.	Massachusetts.	New York.	Vermont.	New Hampshire.	Maine.	Canada.
Color	9	10+	8	8	8+	7	7	9	8	8+	10
Moisture	33.40	33.96	34.02	34.13	34.69	33.33	33.76	34.93	36.31	33.27	34.34
Sucrose (per cent)	62.72	60.73	62.43	62.68	61.73	64.49	64.09	62.24	61.63	63.96	62.24
Invert sugar (per cent)	1.99	3.10	1.63	1.62	2.07	.84	.83	1.23	.58	1.17	1.41
Total ash (per cent)	1.24	1.16	1.07	1.01	.99	.95	.93	.93	.94	1.09	.95
Soluble ash (per cent)	.83	.68	.68	.68	.63	.64	.59	.59	.55	.66	.56
Insoluble ash (per cent)	.41	.48	.39	.33	.36	.31	.34	.34	.39	.43	.39
Per cent of soluble ash÷per cent of insoluble ash	2.02	1.42	1.75	2.06	1.75	2.06	1.73	1.74	1.41	1.51	1.45
Alkalinity of soluble ash (cc)	101	80	81	80	71	80	69	66	72	79	.69
Alkalinity of insoluble ash (cc)	108	124	106	93	99	83	83	87	96	96	.96
Alkalinity of soluble ash÷alkalinity of insoluble ash	.93	.65	.76	.86	.72	.96	.83	.76	.75	.82	.72
Basic lead number	3.82	3.00	2.99	2.73	2.60	2.46	2.39	2.41	2.63	2.33	2.55
Neutral lead number	1.17	1.00	.99	.86	.68	.72	.70	.54	.65	.70	.54
A. O. A. C. malic acid value	1.09	.85	.92	.87	.84	.86	.79	.75	.87	.79	.79
Cowles malic acid value	1.33	1.20	1.12	1.01	1.00	.96	.94	.93	.98	.94	.91

From this table it is seen that some of the constituents decrease as the more northern latitudes are reached. In general, this is true of the total ash and the lead number and to a less degree of the malic acid value. There are a few exceptions to this general tendency which may be due to the altitude of the sugar bush, to the soil, or to the exposure.

Soil data were collected from the individual makers, but on compiling them no distinctions that would admit of any classification were found. No doubt the kind of soil on which the bush is located influences, to a slight extent, the ash content and possibly the malic-

acid value and lead number. Also sirup made from soft and that from hard maples in the same locality might show very distinct differences. The few samples of soft maple sirup collected are hardly sufficient to afford any basis of comparison.

In the hilly country the opening of the season depends on the exposure of the sugar bush, a southern exposure starting the sap earlier than a northern one. The claim is also made that when limestone is present in any quantity the ash of the sap is higher and the "niter" more abundant.

When the States are subdivided into localities and the samples from each averaged, the same striking differences are noted as in the

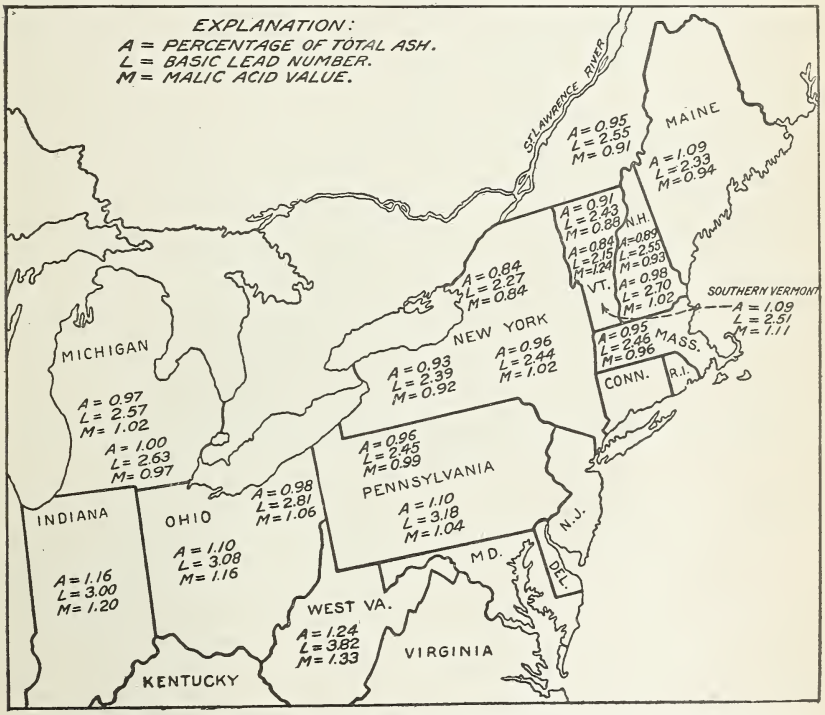

FIG. 5.—Map showing effect of latitude on ash content, lead number, and malic-acid value of maple sirups.

averages of the individual States, namely, the farther north the section is the lower are the ash, the lead number, and the malic acid value. There are exceptions to this, but the averages show the variation noted. The results are tabulated and the data inserted also on the map where the differences are more easily noted. The table shows the location in the State, the names of the counties comprising the section inspected, the number of samples on which the averages were based and the average figures for total ash, insoluble ash, basic lead number, and Cowles malic acid value, figured to the dry basis.

Comparison of averages based on different localities of the same State.

State, section, and county.	Number of samples.	Total ash.	Insoluble ash.	Basic lead number.	Cowles malic acid value.
		Per cent.	*Per cent.*		
Michigan:					
Center and west center—					
Ionia, Kent, Ottawa	11	0.97	0.41	2.57	1.02
South—					
Branch, Eaton, Ingham, Lenawee	12	1.00	.30	2.63	.97
New Hampshire:					
Center—					
Grafton	7	.89	.37	2.55	.93
Southwest—					
Cheshire, Hillsboro, Sullivan	8	.98	.39	2.70	1.02
New York:					
Northeast—					
Lewis	8	.84	.31	2.27	.84
Center—					
Chenango, Cortland, Delaware	18	.96	.33	2.44	1.02
West—					
Allegany, Cattaraugus, Chautauqua, Wyoming	40	.93	.34	2.39	.92
Ohio:					
Northeast—					
Ashtabula, Cuyahoga, Geauga, Mahoning, Portage, Trumbull	44	.98	.36	2.81	1.06
West center, center, and north center—					
Champaign, Logan, Medina, Morrow, Union	97	1.10	.40	3.08	1.16
Pennsylvania:					
Northeast and northwest—					
Bradford, Warren	34	.96	.32	2.45	.99
Southeast and southwest—					
Lancaster, Fayette, Somerset	21	1.10	.32	3.18	1.04
Vermont:					
Northwest—					
Chittenden, Franklin, Lamoille, Orleans	41	.91	.34	2.43	.88
West center—					
Addison and Rutland	5	.89	30	2.15	1.24
South—					
Bennington, Windham	4	1.09	.39	2.51	1.11

STATISTICS OF THE MAPLE SIRUP INDUSTRY OF THE UNITED STATES.

It is a rather difficult task to obtain the actual amount of maple sirup produced in the United States, first, because it is produced in small quantities by many farmers, and, again, a great deal of it does not reach the market but is sold to friends of the makers. The census reports of the years 1850 to 1900 give figures for maple production, sugar only having been reported in 1850 while in the other years sirup was also given. These have been arranged in order of their importance in production of maple sirup as reported by the 1900 census, in which year reports from 62,718 farms were received.

Maple sirup production of the United States (U. S. census reports).

[In gallons.]

No.	State.	1900.	1890.	1880.	1870.	1860.
1	Ohio	923,519	727,142	495,839	352,612	370,512
2	New York	413,159	457,658	266,390	46,048	131,843
3	Indiana	179,576	180,702	242,084	227,880	292,908
4	Vermont	160,918	218,252	128,091	12,023	16,253
5	Pennsylvania	160,297	154,650	140,667	39,385	114,310
6	Michigan	82,997	197,775	131,990	23,637	78,998
7	New Hampshire	41,588	81,997	79,712	16,884	43,833
8	Massachusetts	27,174	33,632	13,017	2,326	15,307
9	Maine	16,024	71,818	82,006	28,470	32,679
10	West Virginia	14,874	19,032	28,696	20,209	.....
11	Illinois	9,357	13,978	40,077	10,378	20,048
12	Wisconsin	6,625	48,006	58,012	31,218	83,118
13	Maryland	5,825	1,021	2,043	374	2,404
14	Missouri	5,474	8,333	16,244	16,317	18,289
15	Iowa	2,662	14,413	17,766	9,315	11,405
16	Kentucky	2,367	10,468	27,530	49,073	140,076
17	Virginia	1,677	3,468	7,518	11,400	99,605
18	Minnesota	1,079	12,091	11,407	12,722	23,038
19	Connecticut	948	1,437	2,173	168	2,277
20	Tennessee	171	1,186	3,688	4,843	74,372
21	North Carolina	129	1,142	582	418	17,759
	Total[a]	2,056,611	2,258,376	1,796,048	921,057	1,597,589

[a] The totals include small amounts not reported under individual States.

The amount of sirup made in the individual States varies somewhat from year to year. Ohio leads in the five years for which the figures are given, New York standing second except in 1860 and 1870. Indiana stands third in two years, being second in 1860 and 1870 and fifth in 1890. Vermont is fourth in 1900, third in 1890, and sixth in 1880, falling far short of this in the other two years. The variation in these figures is influenced partly by the relative production of maple sugar, as some States use much more sap in this way than others. Classifying the States by the quantity of maple sugar, Vermont is first in 1900 with nearly 5,000,000 pounds, New York second with 3,623,540 pounds, Pennsylvania third with 1,429,540 pounds, Ohio fourth with 613,990 pounds, New Hampshire fifth with 441,870 pounds, and Michigan sixth with 302,715 pounds. Considering the total value of maple products, the order is Ohio, New York, Vermont, Pennsylvania, Indiana, Michigan, and New Hampshire.

It is a much mooted question among maple producers as to which pays best, sirup or sugar. Some States, Ohio for example, produce much more sirup than sugar; Vermont, on the contrary, makes comparatively little sirup. It is claimed that about 7.5 to 8 pounds of sugar can be made from 1 gallon of sirup. The sugar requires more boiling than the sirup, but once made it can be kept without much change. When sugar is 10 cents a pound and sirup from 80 cents to $1 a gallon, sirup is more profitable; but with sugar at 15 cents and sirup at $1 sugar is to be preferred. This question must be settled by the individual farmer or maker according to his own local conditions. Knowing the prices of the two products, their relative values can be easily figured.

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